Brackley, Rufus A. Features of Math., Science, English, ...

BOSTON UNIVERSITY
SCHOOL OF EDUCATION

LIBRARY

The Gift of Rufus A. Brackley

Ed.
Service Paper
Brackley, R.A.
1949

stored

Ed.
Service Paper
Brackley, R.A.
1941
Stored

BOSTON UNIVERSITY

SCHOOL OF EDUCATION

Service Paper

A SURVEY OF RECENT LITERATURE TO DETERMINE THE FEATURES OF MATHEMATICS, SCIENCE, ENGLISH, AND SOCIAL-STUDIES CLASSROOMS NECESSARY TO MEET A MODERN EDUCATIONAL PROGRAM AT THE SECONDARY-SCHOOL LEVEL

Submitted by

Rufus Allen Brackley

(A.B., Colby College, 1940)

In partial fulfillment of requirements for
the degree of Master of Education

Boston University
School of Education
Library

Gift of
Rufus A. Brackley
School of Education
June 13, 1949
30914

First Reader: Roy O. Billett, Professor of Education

Second Reader: Frank L. Steeves, Instructor in Education

TABLE OF CONTENTS

CHAPTER PAGE

I. PRELIMINARY CONSIDERATIONS 1

The Plan and Purpose of the Study 1

The Problem 1

Existing undesirable conditions 1

Methods and Organization of Research 2

Methods 2

Organization 3

II. THE MATHEMATICS CLASSROOM 5

The Changing Design of the Mathematics Classroom 5

The mathematics classroom of the traditional high school 5

Influence of teaching method on the features of a classroom 5

Recommendations for Mathematics Classrooms 7

Mary Ruth Cook 7

Comments 9

Mary A. Potter 9

Comments 10

Raleigh Schorling 11

Comments 14

Fred L. Bedford 15

Comments 17

Digitized by the Internet Archive
in 2015

https://archive.org/details/surveyofrecentli00brac

Henry W. Syer 18

Comments 19

L. Grace Carroll 19

Comments 21

Annotated bibliography 22

Essential Features of a Good Mathematics Classroom 23

Conclusions 23

Size of room 24

Furniture 24

Display units 24

Storage space 25

Library provisions 25

Blackboard equipment 26

Bulletin boards and display space materials 26

Chart file 26

General equipment 26

Instruments 26

Library books 27

Magazines and newspapers 29

Models 29

Museum case and show case 30

Shelves and table drawers 30

Teacher's file 30

III. SCIENCE CLASSROOMS 31

The Changing Design of Science Classrooms 31

Traditional science laboratory 31

Factors effecting change 31

The modern science program 32

Recommendations for Science Classrooms 33

Specific suggestions to aid in the planning of the science classrooms 33

Hubert M. Evans 35

Comments 36

Victor D. Smith 38

Comments 42

Vierling Kersey 43

Comments 45

National Society for the Study of Education 46

Comments 51

C. G. Campbell 51

Comments 53

National Council on Schoolhouse Construction 53

Comments 55

Annotated bibliography 55

Essential Features of a Good Science Laboratory 57

Conclusions 57

Equipment 58

Working space 58

Student seating 59

Display space 59

Storage space 60

Library provisions 60
Provisions for audio-visual aids 60
Safety provisions 60
Other provisions 60
IV. THE ENGLISH CLASSROOM 61
The Changing Design of the English Classroom 61
The English classroom of the traditional high school 61
The new English curriculum 61
Recommendations for English Classrooms 62
Letta M. Clark 62
Comments 63
Dora V. Smith 64
Comments 64
W. H. Johnson 65
Comments 67
Roy O. Billett 69
Comments 69
N. L. Engelhardt and Joseph M. Leps 69
Essential Features of a Good English Classroom 70
Conclusions 70
Room size 72
Blackboard 73
Bulletin board 73
Bookcase 73
Cabinets 73

Seat-desk equipment 73

Miscellaneous furniture fixtures 73

Audio-visual aids 73

Miscellaneous 73

Books, magazines, and periodicals 74

V. THE SOCIAL-STUDIES CLASSROOM 75

The Changing Design of the Social Studies Classroom 75

The social-studies classroom of the traditional high school 75

The modern social-studies program 75

Recommendations for Social-Studies Classrooms 76

Lester K. Ade 76

Comments 77

Bining and Bining 77

Comments 79

H. Z. Wooden, A. B. Wrigley, and W. L. Lowe 80

Comments 82

J. W. Baldwin 83

Comments 87

Dorothy Gray and Alice Miel 89

Comments 91

Engelhardt and Leps 92

Comments 92

Annotated bibliography 95

The Essential Features of a Good Social-Studies Classroom 96

Conclusions 96
Size of rooms 98
Blackboard 98
Bookcase 98
Cabinets 98
Seat and desk equipment 98
Bulletin boards 98
Miscellaneous furniture and room fixtures 98
Encyclopedias 99
Newspapers 99
Periodicals 99
Collateral reading 99
Globes 99
Historical wall maps 99
Political-physical wall maps 99
Slated outline maps 99
Pictures and visual aids 100
Multigraphing apparatus 100
Projection lanterns 100
Miscellaneous apparatus and supplies 100
Economic and industrial exhibits 100
Science Equipment 100
VI. OTHER CONSIDERATIONS 101
Common Features 101
Problems common to most classrooms 101

Seating 101
Size of room 102
Floor covering 105
Wall and ceiling decorations 106
Heating and ventilation 107
Lighting 108
A Model Classroom 109
Comments 109
The experiment 110
VII. CONCLUSIONS 113
Summary 113
Writer's conclusions 113
Differing problems of different schools 114
A Checklist 114
Organization of checklist 114
The checklist 115
BIBLIOGRAPHY 121

LIST OF PLANS

PLAN PAGE

1. A Mathematics Classroom 16
2. A Science Laboratory for a Small School. . . . 37
3. A Science Room with Activity and Closed Seat Arrangement 39
4. A Chemistry Laboratory with Recitation Space for 36 Pupils 47
5. Biology or Life Science Laboratory 48
6. Layout of a Chicago High School English Laboratory 68
7. English Laboratory 71
8. A Social-Studies Room 81
9. A Library and a Social-Studies Suite 88
10. A Social-Studies Laboratory. 93
11. Social-Science Laboratory 94

LIST OF TABLES

TABLE PAGE

1. Area Requirements for Recitation-Discussion Program 103

2. Area Requirements for Discussion-Activity Program 104

3. Area Requirements for Experience Program . . 105

CHAPTER I

PRELIMINARY CONSIDERATIONS

The Plan and Purpose of the Study

The problem. -- The purpose of this paper is to report the features of a classroom necessary to meet the needs of a modern educational program in certain subjects in the secondary field, namely: mathematics, English, social studies, and science. The task undertaken is to set forth some of the features of the various subject classrooms which will lend themselves to the modern techniques of teaching in that subject, regardless of whether the school is large or small. It seems possible that a large number of features of the classrooms of these four subjects may be established, leaving the selection of the detailed features to the individual schools which have varying education needs.

Existing undersirable conditions. -- Most of our present classrooms consist of four walls, some chairs, a desk, blackboards, and perhaps a bulletin board. In some instances, one period of the day the room is an English classroom, and the next it is a mathematics classroom. Even if it is used as an English classroom for every period in the day, it differs little, in many schools, from that

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

occupied by another type of activity. It appears to the writer that these classrooms do not provide adequate opportunity for a modern program in education.

Methods and Organization of Research

Methods. -- A survey of the literature on classrooms was made, and those articles which dealt with the modern classroom were selected for reading. The following sources were used to determine current writings on the subject:

1. Education Index
2. Bibliography of Research Studies
3. Review of Educational Research
4. The indexes of current magazines and periodicals were studied. Those selected in this part of the study were School Executive, Mathematics Teacher, School Science and Mathematics, English Journal, American School and University.

This study was based on the various writers' recommendations for a modern classroom, and although this writer's opinion has been expressed from time to time, little attempt has been made to evaluate or validate the recommendations. Carl Porter-Shirley, formerly Superintendent of Schools at Hingham, Massachusetts, now Superintendent of Schools at Newport, Rhode Island, in an interview with the writer regarding this thesis, emphasized the importance of validation of the features of a classroom before

a presentation of the features to a school committee. Porter-Shirley[1], together with a group of teachers at Hingham, gave the seven following basic factors for determining the construction of an elementary school.

1. Pupil Membership
2. Teaching Load
3. School Subjects
4. Extra-Curricular Activities
5. Teaching Methods
6. External Features
7. Location of Classrooms

Although these factors were given for an elementary school, Porter-Shirley considered that they did not change for a secondary school and that these factors were important in the validation of the features of a secondary school classroom.

Organization. -- The first classroom considered is the mathematics classroom. This is followed in order by a consideration of the science, English, and social-studies rooms. The last part of the study contains a consideration of those factors of a classroom which may be considered as common to all, such as seating, size of room, wall and ceiling decorations, heating, lighting,

---

[1] Hingham Public Schools, Analysis of Elementary School Program for the Replacement of the South Elementary School, Hingham Public Schools, Hingham, Massachusetts, (unpublished).

ventilation, and floor covering. The final chapter contains a check list of requirements of a classroom to meet needs of a modern educational program. The validity of this check list can be measured only in the light of the educational needs and aims of an individual community.

CHAPTER II

THE MATHEMATICS CLASSROOM

The Changing Design of the Mathematics Classroom

The mathematics classroom of the traditional high school. -- Too often in the past the teaching of mathematics has taken place in an English or history room that has been free for the period. The mathematics teacher has entered the room armed with a meter stick to use as a straight edge and a piece of chalk to establish the value of mathematical knowledge midst bulletin boards illustrating Shakespeare's Romeo and Juliet or Robert Louis Stevenson's even more exciting Treasure Island. It has been a fortunate teacher, indeed, who has had a room in which mathematics alone has been taught. Under these conditions a teacher works under serious handicaps in attempting to make mathematics a functional subject.

Influence of teaching method on the features of a classroom. -- If a teacher employs the page-by-page daily assignment for classroom recitation and homework as a plan for teaching, there can be no great argument against the need for a mathematics classroom as such. On the other hand, more recent methods of teaching cannot be employed while using the traditional classroom supposedly

satisfactory for the teaching of English, history, French, or algebra. Edith L. Mossman[1] put forth these thoughts on this subject:

> "No principal would think of asking a teacher of drawing, singing, science, manual training, cooking, or sewing to teach in just any room here or there. 'Why of course not,' you say, 'there is too much necessary material and equipment or apparatus that cannot be carried about.' But it is supposed that for mathematics only blackboards with chalk and erasers, and paper and pencils, -- perhaps rulers and dividers, are needed. That subject, therefore, can be taught all right anywhere that a room happens to be free.
>
> As it has been done and still is usually done there could be no argument here. But there soon will be an awakening that will make it just as impossible for a mathematics instructor to carry about the necessities for good teaching as it is for an instructor in art or science."

Seven years later[2] The Joint Commission of Mathematical Association of America, Inc. and of the National Council of Teachers of Mathematics, expressed a similar opinion and placed special emphasis upon need for validation of any program designed to modernize the mathematics classroom.

> "The appropriate furnishing and equipping of a mathematics classroom is receiving more attention than formerly, many teachers not being

---

[1] Edith L. Mossman, "A Mathematics Classroom That Speaks for Itself," School Science and Mathematics 33:423. (April 1933)

[2] Joint Commission of Mathematical Association of America, Inc. and National Council of Teachers of Mathematics, The Place of Mathematics in Secondary Education, Fifteenth Yearbook, National Council of Teachers of Mathematics, Bureau of Publications, Teachers College, Columbia, New York, 1940, p. 238.

content with four walls and a blackboard. The movement is partly a manifestation of general wish to remove the barrenness from schoolrooms and make them congenial places whose good cheer invites study and reflection. But it is also thought that proper equipment aids instruction, if indeed it is not essential for the type of teaching that has been made necessary by the present clientele of the schools.

Although the Commission strongly recommends that careful attention be given to equipping the mathematics classroom so as to aid instruction and stimulate interest, it believes that a balanced point of view should be maintained. The argument for equpment is injured rather than helped if reasons are given that are not sound, or if comparisons are made that are not warranted."

Recommendations For Mathematics Classrooms

Mary Ruth Cook[1].

"We may create a mathematical atmosphere in the following ways:

I. One of the first means of creating a mathematical atmosphere is by the physical equipment of the mathematics classroom.

Does the appearance of your mathematics classroom, because of its equipment, bespeak the fact that it is a room in which mathematics is taught, just at the appearance of the science classroom tells one that it is a place where science is taught? What is some of the equipment that will lend an atmosphere of mathematics to the classroom?

(1) One rather essential piece of equipment for the mathematics classroom is a graph board. This can easily be made by having one section of the blackboard marked off in inch squares preferably with green paint.

---

[1] Mary Ruth Cook, "Stimulating Interest in Mathematics by Creating A Mathematical Atmosphere," Mathematics Teacher, 24:248-254 (April 1931).

(2) A second thing that is quite an asset to a mathematics classroom is a bulletin board on which the pupils and the teachers may post interesting articles, pictures, graphs, etc., which show the uses of mathematics.

(3) A third means of facilitating the work of students in the mathematics classroom is through having such blackboard equipment as yardsticks, blackboard compasses, blackboard protractors, T-Squares, triangles, etc.

(4) A fourth bit of equipment for the mathematics classroom consists of models, a carpenter's level, if possible a transit, an angle mirror, a good slide rule, a decimalized tape, etc.

(5) A fifth thing that lends atmosphere to the classroom is the use of pictures of mathematical interest. One inexpensive set of pictures that most any school can afford for the rooms in which mathematics is taught is the set of prints of mural paintings on the walls of the mathematics rooms of the Lincoln School in New York City. These lovely colored prints portray the History of Mathematics. There are three of these pictures together with a short story of them written by Dr. David Eugene Smith which may be purchased from the Bureau of Publications, Columbia University. Prints of the men who have been prominent in the development of mathematics may be had from various sources, and these contribute materially to the mathematical atmosphere in the classroom... .

(6) Slogans, proverbs, mottoes, and the like bearing upon mathematics is a sixth means of calling attention to the fact that the room is one in which mathematics is taught... .

(7) A reading table in the room with some of the supplementary reading materials that the children can use in connection with the problems they are working on or for leisure reading is another means of creating a mathematical atmosphere... .

II. A second means of creating mathematical atmosphere is by making the child mathematics conscious... .

(1) First, by use of books... .

> (2) A second way of helping to make children mathematics conscious is by use of posters... .
>
> (3) A third way of helping to make the child mathematics conscious is by mathematics exhibits. Posters and booklets together with slogans and the like may be used in the working up of mathematics exhibits."

Comments. -- The description which Cook gives is most valuable because it presents possibilities for a teacher who wishes to change his present traditional mathematics classroom into a room which creates and stimulates mathematical atmosphere. Many classrooms now exist that are so inadequate from the viewpoints of lighting, flexibility, sound-proofing, and size that they can never become entirely satisfactory. However, the fact that even these rooms can be improved as instruments of instruction should not be overlooked. The stimulating atmosphere which Cook wishes to create is one of the most important factors in a modern classroom for mathematics.

Mary A. Potter[1].

> "We find a room planned to be a mathematics laboratory which is not a social-science or typing room that happens to be vacant the period at which a mathematics class recites. It has built-in bulletin boards used for mathematics displays; it has show cases, perhaps a table, for exhibiting temporary collections; it has large cupboards and many drawers in which material is stored; it has a graph chart hung where it can be used at a moment's notice; it has a demonstration slide rule; we see a screen which shows that there is a projector available we feel a mathematical air imparted.

---

[1] Mary A. Potter, "The Mathematics Laboratory," *School Science and Mathematics*, 44:367-373 (April 1944).

> by the pictures on the walls; and at the front of the room we see a mural which, Miss Jones explains, was made by a mathematics club.
>
> Because they would get dirty otherwise and because in profusion they are confusing rather than stimulating, Miss Jones keeps most of the models and such materials in her spacious cupboards, taking them out when they are used to illustrate some principle or teach a concept. We have permission to peek into the cupboards and see what they contain."

Comments.-- The equipment found in the cupboards is listed below:

Models, prisms, cylinders, cubes, spheres, cones, 1728 cubic inches.

Transit, discarded gas meter, cardboard clock face, six blackboard rulers and compasses, a blackboard protractor.

Thermometers, centigrade and Fahrenheit.

Inexpensive scales.

Boxes of paper money.

Set of measures, quart, pint, peck, bushel.

Carpenter's level and plumb line, rope, a meter stick, fifty-foot-cotton tape.

Rulers, compasses, protractors, scissors, various types of squared paper, colored paper, gummed paper both transparent for hinges and colored for making bar graphs, colored wax crayons and chalk, paste, tag board, balsa wood, blank business forms, different sized envelopes for storage and paper-picnic plates.

Books and magazines on mathematics.

File of moving pictures, slide films, film strips, colored slides from Kodachromes.

File of student made posters, some illustrated by use of pictures from newspapers and magazines.

Potter, Supervisor of Mathematics at Racine, Wisconsin, insists that a room in which mathematics is taught must be designed for the teaching of that subject. The room which she describes is planned for the junior-high-school level. The type of equipment is somewhat different from that of classrooms designed for the senior-high-school grades. Display features, working space, blackboard provisions, storage room, and audiovisual needs are essentially the same in both instances.

Raleigh Schorling[1].

> "The conventional recitation room for mathematics classes should be replaced by the mathematics laboratory. A mathematics classroom should have personality. Pupils and teachers working together can create an atmosphere that is appropriate to the tasks. It should not only be a good place for pupils to work but should also present an attractive situation to any who enter into it. This can be accomplished without excessive cost. Note in the picture on this page the flexible furniture with flat-top tables and comfortable chairs, the battleship linoleum on the floor that is easily kept clean, the generous amount of bulletin board with neatly arranged and instructive exhibits, the blackboard ruled in squares and located where pupils can see figures drawn on it, and the large slide rule at the front of the room. In the back

---

[1] Raleigh Schorling, the Teaching of Mathematics, The Ann Arbor Press, Ann Arbor, Michigan, 1936, p. 81-86.

of the room one would expect to find generous provision for storage of materials, built-in cases for books and pamphlets to supplement the textbooks, and files for pupil records and exhibit materials. The setting contributes to informality of procedure and friendliness of tone.

In the picture shown on this page the pupils are beginning their study of the transit. One can assume that here discipline allows freedom in which disorder and discourtesy have no place. In brief, the pictures present the concept of a modern mathematics laboratory.

In large measure the success of the new courses depends on the degree to which the classroom takes on the physical appearance, spirit and attitude of a well-taught science laboratory in which development of new principles, the assignment, supervised study, recitation and appraisal all find their place and are economically interrelated. It is not enough that these desirable facilities be provided; they must be arranged to present a unified, attractive picture. Providing for mathematics an adequate equipment and a setting that is convenient and appropriate, has long been neglected. It is hoped that a careful study of the requirements of a good workroom will result in increasing the number of mathematics rooms that suggest not the county jail but an attractive and pleasant home... .

We shall classify mathematics equipment as (1) the pupils' individual equipment, (2) the classroom equipment, (3) the school's equipment in the mathematics laboratory, and (4) books, pamphlets, and magazines in the mathematics library.

It is desirable for each pupil to possess and to have available when needed the following personal equipment: (1) a loose-leaf notebook for pages $8\frac{1}{2}$" by 11", containing both plain and squared paper, (2) a protractor, preferably a metal one with black graduations, (3) a ruler graduated in both inches and centimeters, (4) a pencil, not too soft, about 2H or No. 3, (5) pencil compasses of good quality, and (6) a textbook. The squared paper should be divided into centimeters to facilitate the learning of the metric system, or divided into inches and

tenths of an inch. Note that both types of paper provide practice with the decimal system.

Every mathematics classroom should contain --

1. A bulletin board for posting assignments and exhibiting good work. We have never seen a classroom with too much bulletin board space.

2. A built-in case to provide storage for reference books, materials and models.

3. A section of 'squared blackboard'... .

4. Blackboard equipment including (a) two large protractors, (b) two wooden triangles (45-45-90, and 60-30-90), (c) a dozen straight edges, some of which have handles, (d) a dozen good pupil compasses for emergency loan, and (e) several good pointers.

5. A good pencil sharpener fastened in a convenient place.

6. Several pictures appropriate to a mathematics room.

7. Miscellaneous items such as (a) string, colored crayons, and scissors, (b) gummed paper to be used in making bar graphs, (c) a tape line 25 or 50 ft. long, (d) a carpenter's folding rule 6 ft. long and (e) a supply of rulers, compasses, protractors, and notebook paper, to be kept on hand for lending to the pupils in case of emergency... .

The mathematics laboratory, which in a small high school will perhaps be nothing more than a storeroom, should contain some of the following equipment.

1. A set of model solids preferably the kind that can be taken apart. These can be made by pupils at home or in the general shop.

2. A spherical blackboard for solid geometry.

3. A five-foot demonstration slide rule.

4. Thirty inexpensive slide rules.

5. One or more high-grade slide rules.

6. Kaleidscope.

7. Pantagraph.

8. Plane table.

9. An inexpensive sextant.

10. Surveying equipment: A transit, a level, leveling rod, steel chain, several steel tapes, wire pins, red-and-white sight rods, and engineer's notebooks. The alert teacher will usually find someone in a community who will be glad to lend some of the objects or even demonstrate their use.

Some good work can be done with homemade instruments and models. For example, pupils can make a simple slide rule from a piece of cardboard and a sheet of logarithmic graph paper. With this, he can learn the principles applied when a slide rule is operated... .

In addition to supplementary books on the bookshelf in each classroom there should be an ample supply of reading materials such as a few histories of mathematics, the Mathematics Teacher, tables of mathematics, and books on mathematical recreations. It must be admitted that mathematics is a subjects for which the library materials are meager... .

Finally it is suggested that whenever possible the traditional nailed-to-the-floor desks be replaced by flat-top work tables preferably in two sizes, say one group 30 inches high and another 27½ inches with comfortable chairs to match. Flexible furniture contributes not only to informality, but also a variety of procedure and the assignment of differential tasks."

Comments. -- Schorling, Head of the Department of Mathematics in the University High School, University of Michigan, gives a description of the mathematics classroom which he considers adequate in a modern program of education. In his book pictures of a mathematics classroom are shown. The equipment of the room is comparatively inex-

pensive. Much of it can be borrowed from students or interested people. Much of the equipment needed for this room is very durable and if purchased will not need replacing for many years. If this equipment is to become a part of the classroom, storage space must be provided.

The informal atmosphere required to make the use of this room most successful can not be accomplished without the use of modern techniques of instruction in the hands of a capable instructor.

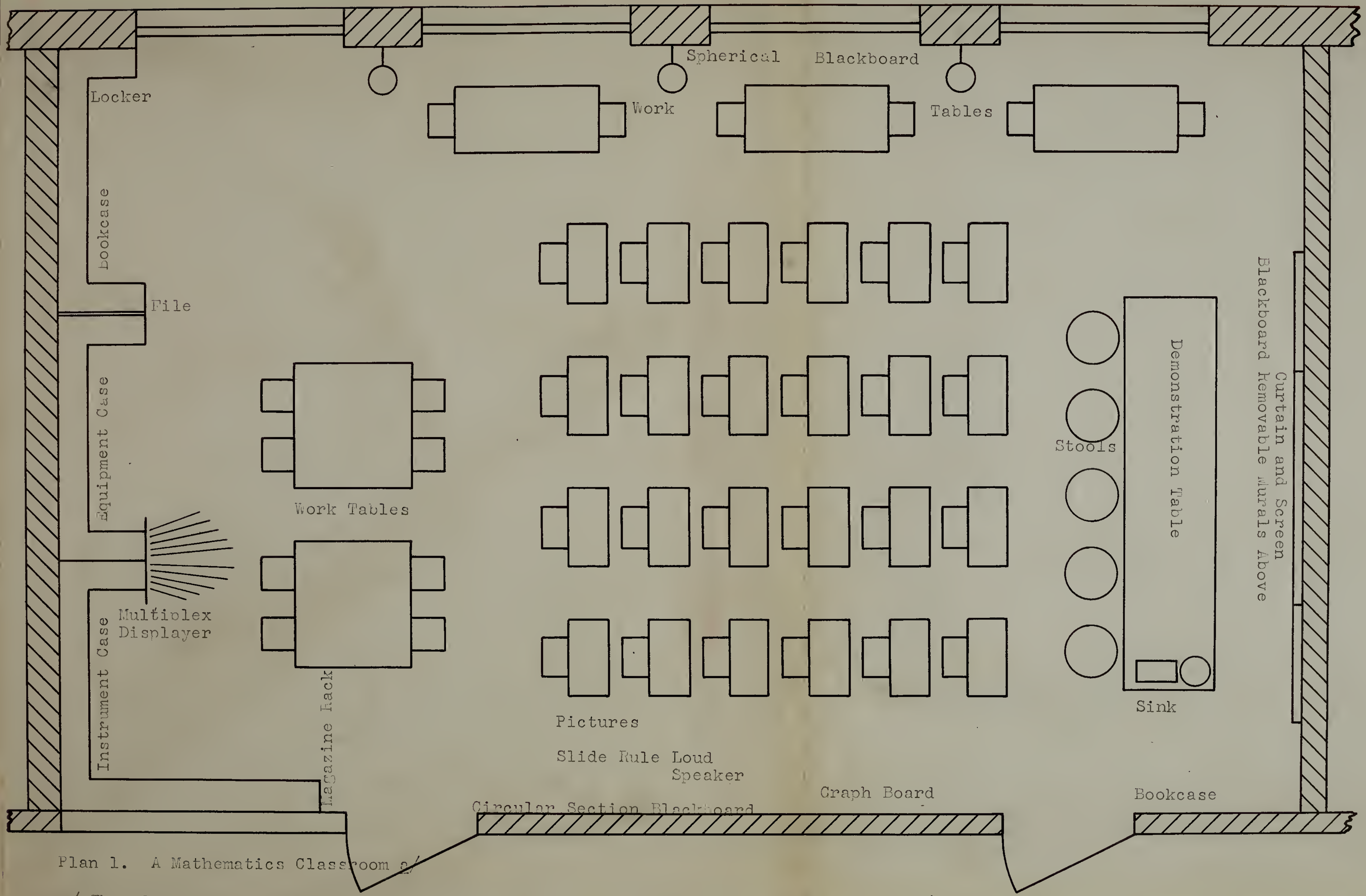
Fred L. Bedford[1]. -- Another specific recommendation for the features of a mathematics classroom on the secondary level is made by Fred L. Bedford, Associate Professor of Mathematics, New Jersey State Teachers' College, Jersey City, New Jersey. A simple reproduction of his room diagram is shown.[2] The desk and chairs are arranged for 24 pupils with work space provided for 12 at one time. The demonstration table is at the front of the room and has a sink as well as water, electricity, and supports for experiments in mechanics. Ample storage

---

[1] Fred L. Bedford, "Designing the Mathematics Classroom," American School and University, Eighteenth Annual Edition American School Publishing Corporation, New York, 1946, p. 199-202.

Also, Fred L. Bedford, "Planning the Mathematics Classroom," School Executive, 55:290-292 (April 1936).

[2] Plan 1 page 16.


Spherical Blackboard
Locker
Work Tables
Bookcase
File
Equipment Case
Work Tables
Multiplex Displayer
Instrument Case
Magazine Rack
Pictures
Slide Rule Loud Speaker
Circular Section Blackboard
Graph Board
Bookcase
Stools
Demonstration Table
Sink
Curtain and Screen
Blackboard Removable Murals Above

Plan 1. A Mathematics Classroom a/

a/ The plan on this page has been adapted by the writer.

space is provided by use of closets, files, and drawers in the work tables, and shelves for the classroom library. The display space has been enlarged by the use of a built-in multiplex fixture at the back of the room and the use of removable panels on the upper part of the end walls. The panels slide into grooves at the top and bottom but may be removed easily by inserting a window pole in a small hole bored in the top of each panel. An exhibit case and bulletin board may also be provided outside the classroom to popularize mathematics. The chalkboard on the inside wall elevation includes a cross-section board and a removable circular section. Elsewhere in the room is a large spherical chalkboard and several smaller ones for student use. Above the chalkboard on the front wall is a motion-picture screen and two curtains to make it possible to cover the board when that is desirable. Ample provision is also made in the room for use of motion-picture, slide, and opaque projectors.

Comments. -- Bedford's article contains a list of equipment and library books which might be found in a mathematics classroom. The list at the end of the chapter is obtained for the most part from this article. If a room is to contain all or most of this equipment, the large amount of storage space for which Bedford plans becomes a necessity.

A room of this type would be more expensive than the traditional classroom, but through careful planning it should be within the financial reach of most schools. These room features will be attained most easily by those who are building new schools. All of the features cannot be adequately provided for in most classrooms which are already built. If full advantage is to be taken of a room with all of these facilities, the traditional methods of day-by-day assignment and question-and-answer recitation cannot be employed. Modern methods of teaching must be used.

Henry W. Syer[1].

> "Before we leave the mathematics laboratory, however, let us take a closer look at it.
>
> It is a large room, used for nothing other than a mathematics laboratory. Here may be left, from day to day, the equipment and materials used in many experiments without fear that they will be destroyed or displaced by meddling. It must never be just a corner of a room used for some other purpose or sight will be lost of the fact that experiments performed there are performed for their mathematical content, and not to help teachers of other courses, not to give pupils the extra work in laboratory manipulation they have not been able to do elsewhere.
>
> Specifically we see, along the windowed wall, a sink and table for plaster of paris work and a table for wood and metal work. Against the wall opposite the windows are two cases, one for exhibits, the other for books. One of the end walls

---

[1] Henry W. Syer, "The Effects of Military Training upon General Education", Mathematics Teacher, 39:3-16, (January 1946).

> supports shelves and cabinets for storage of apparatus; the other, map stands, storage cabinets to hold posters and charts, and a file cabinet. In one corner is the desk of the teacher, facing two library tables, for student study and paper work, one physics table with gas and electrical fixtures, one work table, and two drafting tables. In addition there are two blackboards, one flat and one spherical, and a bulletin board. Here, as simply as that we have our mathematics laboratory."

Comments. -- Henry W. Syer was an officer in the United States Army when this recommendation was written. He is now Assistant Professor of Education at Boston University. This mathematics laboratory is designed for use at two levels. (1) Grade 10 and 11 students who have taken one year of algebra but not plane geometry, and (2) Grade 12 students who have taken at least one year of albebra and one year of plane geometry. It is designed to allow these students to gain practical knowledge of mathematical laws. The size of the recommended room would vary with the size of the school for which it was designed. An informal atmosphere would undoubtedly be found in a classroom of this type when the room is used to its greatest advantage by the teacher.

L. Grace Carroll[1].

> "What is a mathematics laboratory? It is a place for learning by doing. Any laboratory is a

---

[1] L. Grace Carroll, "Mathematics Classroom Becomes a Laboratory", Multi-Sensory Aids in the Teaching of Mathematics, Eighteenth Yearbook, Bureau of Publications, Teachers College, Columbia, New York, 1943, p. 16-29.

workshop. One concept of a mathematics laboratory is an environment in which a pupil learns efficiently and more meaningfully the mathematics he should learn anyway. The teaching is informal and individual, with all possible opportunities offered to discover or rediscover mathematical truths and laws. Visual aids are used in making the work as objective as the problems required and the facilities permit. Just how this is done will vary, but a few illustrations of ways in which we have done it are given in this article.

How will a mathematics laboratory differ from any other classroom? The answer to this question is found in part in any classroom used by a progressive teacher. Equipment (or its lack) is not the only distinguishing factor. There is an informal type of teaching and a type of directed study, both of which vitalize the teaching of mathematics. These help to make the room a workshop instead of a lecture room. There is more 'If...Then' discussion followed by discovery and increased development of power of discovery... .

Can more than one teacher use the same mathematics laboratory? This is possible and in some cases it may be desirable. But, in general, a teacher prefers to convert her own classroom into a laboratory. However, she usually is willing to share materials and ideas with other teachers who are actively interested... .

What extra expense will be involved in developing a laboratory? The expense of a laboratory will depend on a number of things. The students and teacher can provide much of the necessary equipment. The expense need not be great. On the other hand, there is much that can be done if money is available.

What equipment is needed? Ample blackboard space is imperative. For graph work one section of the blackboard should be ruled and outlined in pale green or yellow paint, with heavier lines defining every fifth or tenth space. If blackboard space is limited, a substitute is heavy white cardboard, ruled with ink and then covered with a film of Protectophane. If cardboard is the background, wax crayon is used instead of chalk. It

> can be rubbed off with tissue or a piece of cloth. The squared cardboard can be hung in a convenient spot or rested on the chalk tray. When not in use, it can occupy any convenient place, but it should always be accessible.
>
> If the teacher prefers fixed desks and chairs, they should be placed to one side of the room and space left free for group work, conferences, and pupil discussion.
>
> Textbooks other than the regular class textbook should also be available in the laboratory library, since the point of view and methods of different authors should be given consideration. In addition, various reference books, magazines, and other books of cultural, and historical value should be found in the library. This library should be a regular part of the laboratory equipment. It may be supplemented by temporary loans from the school or public library.
>
> As materials accumulate it is necessary to add bulletin boards, bookcases, exhibit shelves, and filing cabinets so that the materials may be used efficiently and saved for future reference. This equipment need not be expensive. In many schools it can be made in the school shops or by interested individual students or teachers. Often there are in storerooms or vacant classrooms unused cases that have long been forgotten and can be used to good advantage here.
>
> Space is needed in the laboratory for the exhibition of posters, clippings, classroom work, etc. A section of wall covered with beaver board is excellent for the purpose. A strip of such material above the blackboard is also a help, as is a swing-wing display board."

Comments. -- Carroll suggests that any mathematics classroom can become a mathematics laboratory. This writer feels that although most classrooms can be adapted to some of the features of a laboratory, many cannot become entirely functional as such. A traditional classroom with

fixed seats which is already too small for a class of twenty-five cannot be adequately transformed into a mathematics laboratory. A teacher who is confronted by this situation should, however, make considerations for improvements. Although much improvement can be made without great expense, a moderate expenditure carefully spent can help a great deal.

Also included in the article is a list of equipment suggested for a classroom laboratory. This list is incorporated in the summary list of equipment at the end of this chapter. Carroll indicates that the teaching techniques used in a mathematics laboratory must create an informal atmosphere.

Annotated bibliography. -- Several other references concerning the mathematics classroom are given below. Although they were not selected by the writer for extended comment, they present ideas regarding the mathematics classroom. They are listed here for easy reference with notes to tell which phases of the mathematics classroom and its equipment each covers.

Engelhardt, N. L. and Joseph M. Leps, "Designing Secondary School Classrooms," American School and University, Fourteenth Annual Edition, American School Publishing Corporation, New York, 1942 p. 249. The floor plan and elevation of a mathematics laboratory is given. This laboratory consists of two parts, a workroom and a recitation room.

Heard, Ida Mae, "Vitalizing Mathematics through Classroom Atmosphere, " *Mathematics Teacher*,35:365-368 (December 1942). This article describes how a traditional mathematics classroom was changed with little expense into one which displays a stimulating atmosphere.

Kee, Olive A., "A Mathematical Atmosphere," *National Council of Teachers of Mathematics*, *Third Yearbook*, Bureau of Publications, Teachers College, Columbia University, New York, 1928, p. 268-276. Kee offers an approach to mathematics through the use of posters, graphs, slogans, newspaper clippings, and a reading table. A list of mathematical equipment is also suggested.

National Council of Teachers of Mathematics, *Multi-Sensory Aids in the Teaching of Mathematics*, *Eighteenth Yearbook* Bureau of Publications, Teachers College, Columbia University, New York, 1943, 455 p. This yearbook has been devoted to recording various types of devices which lead to better understanding of mathematics. It would be particularly valuable to a teacher transforming a mathematics classroom into a mathematics laboratory. Many of the devices can be made by either the pupils or the teacher.

Ramseyer, John A. "The Mathematics Laboratory -- a Device for Vitalizing Mathematics," *Mathematics Teacher*, 28:228-233 (April 1933). In order to show the place mathematics plays in our world, Ramseyer suggests the supplementation of present teaching methods with the laboratory method. A typical-laboratory classroom and its equipment are described.

Essential Features of a Good Mathematics Classroom

Conclusions. -- A good mathematics classroom should be designed only for teaching mathematics. It is desirable that the room be used by only one teacher, although the equipment and ideas for improving the classroom may be shared by several teachers. The best constructed and

most fully equipped classroom will not meet the needs of education unless it is placed in the hands of a competent teacher. The teacher is undoubtedly the most important factor in the most effective classroom. The following features should be considered by those schools which are attempting to provide a modern educational program and those features incorporated which will increase the effectiveness of the instruction of mathematics within that school.

Size of room. -- Accommodations in a mathematics laboratory should be large enough to provide for the activities of 20-25 pupils. Engelhardt and Leps[1] recommend a recitation room 22 by 44 feet plus a workroom 10 and one half by 22 feet.

Furniture.

1. Movable seats and desks or tables and chairs.

2. Work table for one half of pupils with storage space for supplies and equipment.

3. Demonstration table with sink, water, electricity, and supports for mechanical experiment.

Display units.

1. Use of "multiplex displayer" and several bulletin boards with interchangeable tackboards recommended.

---

[1] N. L. Engelhardt and Joseph M. Leps, "Designing Secondary School Classrooms," American School and University, Fourteenth Annual Edition, American School Publishing Corporation, New York, 1942, p. 249.

2. One show case.

3. One exhibit table.

4. Blackboard (25 - 45 linear feet should be ample in most instances).

5. Map stands.

Storage space.

1. One closet.

2. Two or three cupboards.

3. Two or three files.

4. Drawer space under demonstration table.

5. Teachers' desks for confidential material.

Library provisions.

Several library shelves and magazine racks should be sufficient in most classrooms as the individual seats or tables may be used for reading and study.

Given below is a master list of mathematical equipment taken from the articles read by the writer. A great part of this list is taken from Bedford.[1] A few additions are made. It is not expected that one classroom will have all of this equipment or only this, but it is expected that if the laboratory techniques of

---

[1] Op. cit., American School and University, p. 201-202.

teaching are used, every classroom must have much of this equipment. The individual teacher must pick and choose that which he can use.

Blackboard equipment. -- Blackboard compasses, demonstration protractor, gravity protractors, meter sticks, straight edges, 30-60 right triangles, 45-45 right triangles, squared section of blackboard (three to four feet square), stencils, pointers, T-squares, spherical blackboards (one large for demonstration and several small for pupil use).

Bulletin boards and display space materials. -- Clippings on mathematics, drawings, pictures, maps, exhibits of how maps are made, posters, graphs, model work.

Chart file. -- Blueprints; charts made by previous classes; charts showing the use of mathematics in conservation, communication, and industry; graphs; gunnery charts; maps; pictures of buildings and bridges; proverbs relating to mathematics.

General equipment. -- Opaque projector, motion-picture camera, motion-picture projector, motion-picture screen, projection lantern, radio, slides, kaleidoscope.

Instruments. -- Alidades, astrolabe, angle mirrors, arrows, balances and weights, calculating machines, calipers, circumferenter, decimalized tape, demonstration protractor with two-foot diameter, demonstration slide rule,

drawing boards, field protractor, French curves, gear sets, hand levels, hypsometers, inclined plane, Jacob staffs, law of lever set, lens set, leveling rods, magnetic compasses, measuring set (pint, quart, gallon, peck, bushel, liter), measuring tapes, mechanical drawing sets, micrometer screw, pantographs, parallel rulers, plane tables, planimeter, plumb bobs, proportional dividers, protractors, pulley set, ranging poles, resolution of forces board, rulers (metric and foot, marked in tenths and hundredths of a foot and in inches), seconds pendulum, sector compasses, sextants, slide rules, spleen curves, spherometer, spring scales, steel tapes, stop watch, sun dials, surveyor's levels, theodolite, transits, triangles, T-squares, wedge, wheel and axle set.

Library books. -- Because the number of books useful in a mathematics classroom is small, Bedford's[1] recommendations are listed here. There are others which many teachers will find useful in a mathematics library.

Abbott, E. A., Flatland, Boston: Little, Brown & Co., 1915.

Ball, W. W. R., Mathematical Recreations and Essays, New York: The MacMillan Co., 1920.

Collins, A., Fun with Figures, New York: Appleton-Century Co., 1928.

---

[1] Op. cit., American School and University, p. 202.

Dantzig, T., Number, The Language of Science, New York: The MacMillan Co., 1933.

Hodgman, C. D., Mathematical Tables from Handbook of Chemistry and Physics, Cleveland: Chemical Rubber Publishing Co., 1936.

Hogben, L., Mathematics for the Million, New York: W. W. Norton Co., 1937.

Licke, H. E., Recreations in Mathematics, New York: D. Van Nostrand Co., 1917.

Merrill, H. A., Mathematical Excursions, Norwood, Massachusetts: The Normal Press.

Parker, Bertha M., The Story of Numbers, Washington, D.C.: The American Council on Education, 1932.

Popular Mechanics, "Make it Yourself," Chicago: Popular Mechanics Press.

Popular Mechanics, "The Boy Mechanic," Chicago: Popular Mechanics Press.

Row, T. S., Geometric Exercises in Paper Folding, Chicago: Open Court Publishing Co., 1905.

Sanford, Vera, A Short History of Mathematics, New York: Houghton Mifflin Co., 1930.

Shuster, C. N. and Bedford, F. L., Field Work in Mathematics, New York: American Book Co., 1935.

Smith, D. E., Number Stories of Long Ago, Chicago: Ginn & Co., 1919.

Smith, D. E., Our Debt to Greece and Rome, Boston: Marshall Jones Company, 1923.

Smith, D. E., and Ginsburg, J., Numbers and Numerals, New York: Bureau of Publications, Teachers College, Columbia University, 1937.

Thouless, R. H., Straight and Crooked Thinking, New York: Simon and Shuster, 1932.

Weems, P. V. H., Air Navigation, New York: McGraw-Hill Book Company, 1928.

Weems P. V. H., Line of Position Book, Annapolis: U. S. Naval Institute, 1928.

White, W. F., A Scrapbook of Elementary Mathematics, Chicago: Open Court Publishing Co., 1927.

Woodring and Sanford, Enriched Teaching of Mathematics, New York: Bureau of Publications, Teachers College, Columbia University, 1938.

Magazines and newspapers. -- Popular Science, Science, School Science and Mathematics, The New York Times, The Mathematics Teacher, The Scientific American, The Wall Street Journal, Time.

Models. -- Celestial globe, contour map model, dissected cone, geometrical surfaces and solids, Hamley multi-model geometric construction set, analytic solids, hyperboloid, ellipsoid, paraboloid, hyperboloid of one sheet, hyperboloid of two sheets, Platonic solids, prism

and pyramid of same altitude and base, set of Lafayette screen solid geometry models, sphere, sphere in sections, sun dial.

Museum case and show case. -- Abacus, ancient clocks, ancient surveying instruments, collection of slide rules (log, twenty-inch and circular), Gunter's scale, globes (ordinary and markable surface), historical articles and models of interest in mathematics, models made by pupils, Napier's bones, project material, tally sticks.

Shelves and table drawers. -- Graph paper (rectangular, logarithmic, semi-logarithmic, and polar), mathematics library books, mimeograph material, general supplies (paper, drawing instruments, string, colored chalk, modeling clay), Bristol board, pasteboard, cellophane, protectophane, tracing material.

Teacher's file. -- Bibliographies, demonstration material, flash cards, mimeographed material, records, tests.

CHAPTER III

SCIENCE CLASSROOMS

The Changing Design of Science Classrooms

Traditional science laboratory. -- Of the classrooms being considered in this paper the science laboratory of the traditional school more nearly represents that needed for to-day's modern program than does the classroom of the other subjects. This does not mean that the laboratory or science classrooms are adequate to meet the educational needs of to-day's school, but rather that most of these traditional rooms did allow for pupil activity in the form of individual or group experiments. These classrooms did provide pupil-working space and pupil activity that was not permitted or possible in the other classrooms.

Factors effecting change. -- The approach to science in the traditional school was that of formalized study which aimed to develop a specialist in science out of the student. In the past the only type of activity expected of the pupils was that of directed experimentation. To-day, the directed experiment has practically disappeared from the general science curriculum and is under attack

in biology, physics, and chemistry. This does not indicate the disappearance of pupil activity from these courses but a substitution of informal activity and experimentation for the formalized study.

The advance which furniture makers have achieved in the design of furniture has made a marked change in the modern laboratories. Indeed, even the recent advance in the field of atomic science will leave its mark on the design of the laboratory which best meets the needs of today's youth. It was only a few years ago that we felt safe in the field of elementary chemistry. Hours were spent in the experimental proof of certain hypotheses which are no longer believed to be true. Results of atomic research may lead to a new and fresher approach to the subject.

Another fact effecting classroom changes is the vastly increased emphasis upon the subject for all people. This can lead us to but one conclusion that more generalized courses must be offered that will make many better informed rather than create specialists of a few.

The modern science program. -- The National Society for the Study of Education1/ has indicated that a preferred

---

1/ National Society for the Study of Education, Committee on the Teaching of Science, _A Program for Teaching Science_, _Thirty-First Yearbook_, _Part I_, Public School Publishing Company, Bloomington, Illinois, 1932, p. 7-11.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

program on the secondary-school level would include courses in general science required of all students to meet three times a week in grades seven and eight, and five times a week in grade nine. For present, there would be no required courses after grade nine, but there should be introduced in grades ten, eleven, and twelve, two two-year sequences of science courses, one mainly biological and the other mainly physical. The first course in each sequence should be general in nature, and the second course more specialized. No student should be allowed to enter the specialized course in either sequence until completion of both general courses. The Society recommended that these courses become required if eventually possible.

Recommendations for Science Classrooms

Specific suggestions to aid in the planning of the science classroom. -- The National Council on Schoolhouse Construction[1] has this to say regarding science classroom planning:

> "Rooms and equipment for natural sciences should be based on the contemplated science program. Secondary school science rooms must provide facilities for teacher demonstration, lecture, pupil experimentation, recitation, and audio-visual methods."

---

[1] National Council on Schoolhouse Construction, Part I, Proceedings of the Twenty-third Annual Meeting, 1946, p. 83.

In 1945 Victor C. Smith,[1] Head of Ramsey Junior High School, Minneapolis, Minnesota, lists the following activities for which any classroom must provide:

> "Reading of textbooks, references and magazines.
> Demonstrations by teacher and pupil.
> Visual aids including motion pictures, still films, and television.
> Pupil activities including experiments.
> Tests and other measuring exercises.
> So-called club activities such as photography, nature study, gardening, and radio which will eventually become class activity."

Smith[2] also gives the following five general principles to be kept in mind when planning a science classroom.

> "1. The science classroom is a special room adapted to the unique activities of science.
>
> 2. The science room must be planned as a unit, including all permanent equipment in the plan.
>
> 3. The science classroom must be flexible enough to provide for a large variety of activities in a single room avoiding the building of expensive, little used special laboratories, conservatories, darkrooms, projection rooms, etc.
>
> 4. For economy, the room must serve as many activities as possible and must make the best possible use of space.
>
> 5. The science classroom must conform to the general standards of comfort, attractiveness, sanitation, illumination, and safety required of all academic classrooms."

---

[1] Victor C. Smith, "The Functional General Science Classroom," American School Board Journal, 111:46, (November 1946).

[2] Op. cit., p. 47.

Although these suggestions are made specifically in regard to a general science classroom, it seems to this writer that they can be applied to other types of science rooms as well, particularly in view of the fact that many science courses are becoming more generalized.

Hubert M. Evans[1].

> "Before discussing the various items that must be considered when planning a laboratory-workshop for science education in a small secondary school, certain assumptions should be made clear. It is assumed here that the average small secondary school is a four year high school enrolling 200 pupils or less and that in such a school, general science and general biology are offered yearly and physics or chemistry in alternative years. It is further assumed that many small secondary schools are or will be trying out or experimenting with a course in physical science comparable to general biology, and possibly experimenting with other courses or 'areas of experience' where science is taught in relation to other subject matter fields.
>
> It is also assumed that many if not most small secondary schools will find it unnecessary to provide more than one science laboratory. In those schools where two laboratories are needed and can be justified, it is more than likely that the general purpose laboratory described below will be the most useful. Finally, it is assumed that it will be necessary to use the laboratory space to near maximum capacity
>
> The description and plan for laboratory arrangement which follow should be considered as suggestions for planning a general purpose laboratory for small secondary schools. Modi-

---

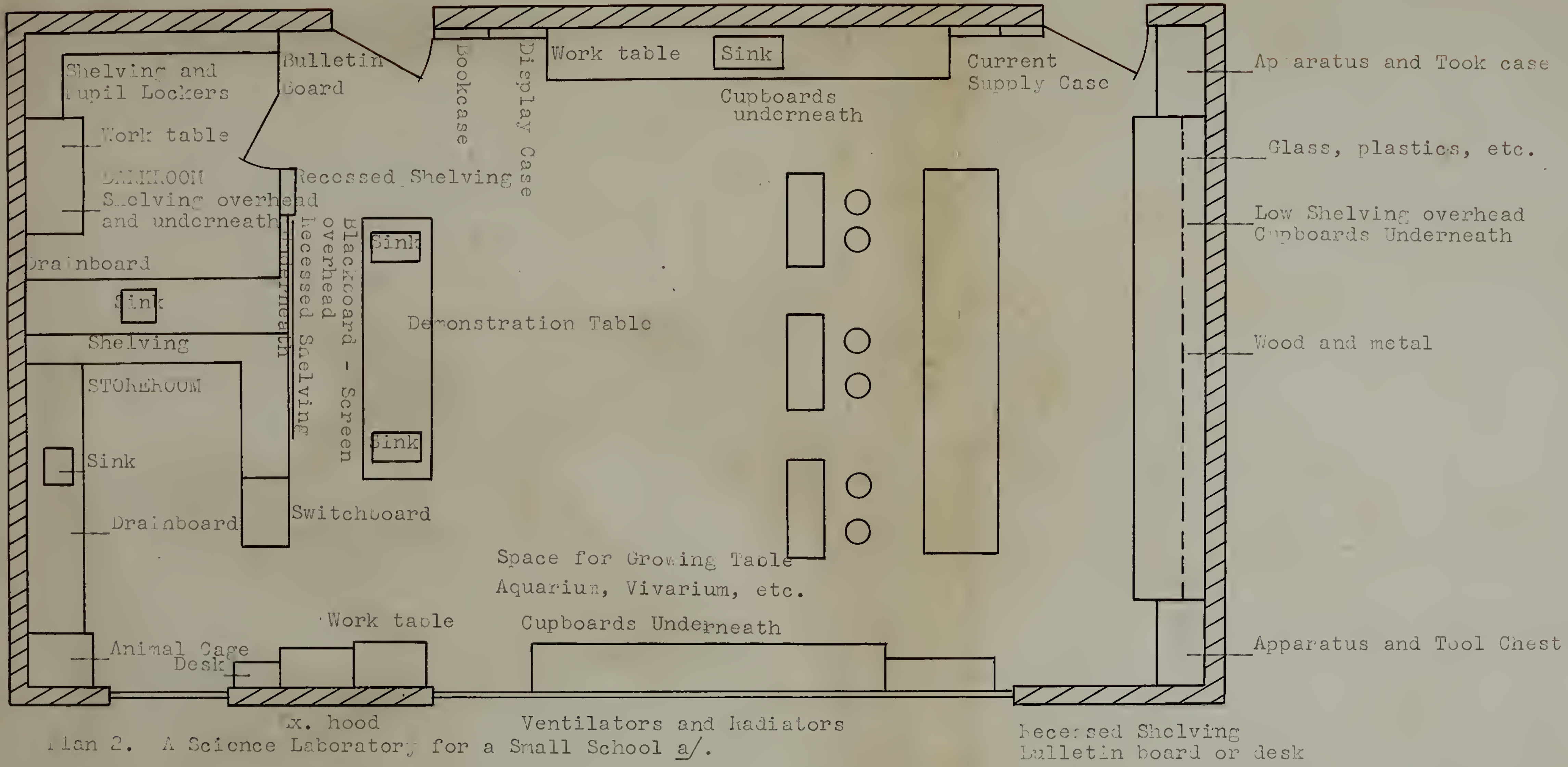
[1] Hubert M. Evans, "Science Laboratory -- Workshop for a Small School," School Executive, 85: 52-54 (July 1946).

> fications will undoubtedly have to be made in terms of local needs and resources. However, the suggestions do, to a large extent, embody a considerable amount of practical experience with laboratories in small schools."

Comments. -- Evans, Assistant Professor of Natural Science, Teachers College, Columbia, recommends the floor plan[1] of a science laboratory for a school of 200 or less pupils. It is designed for a maximum class load of 35 pupils with 24 a preferred number. The center should be free from fixed furniture, but should allow for movable chairs and other furniture. The pupils' tables are four by one and one-half feet for two pupils. The demonstration table can be used by both the teacher and pupils. Twelve pupils have work room on the large work table in the rear. The darkroom and the storeroom could be smaller but in no case should either be smaller than one-hundred square feet of floor space. It is assumed that there will be ample electric, gas, and fixtures for other services available at worktables where needed. The windows can be darkened for projection purposes. It should be noted that although there is a great deal of storage space in this room, no special provision is made for a file, which is considered by most

---

[1] Plan 2 page 37.


Shelving and Pupil Lockers
Bulletin Board
Bookcase
Display Case
Work table
Sink
Cupboards underneath
Current Supply Case
Apparatus and Took case
Work table
DARKROOM
Shelving overhead and underneath
Recessed Shelving
Glass, plastics, etc.
Low Shelving overhead Cupboards Underneath
Drainboard
Sink
Recessed Shelving overhead Underneath
Blackboard - Screen
Sink
Demonstration Table
Sink
Shelving
Wood and metal
STOREROOM
Sink
Drainboard
Switchboard
Space for Growing Table Aquarium, Vivarium, etc.
Work table
Cupboards Underneath
Animal Cage
Desk
Apparatus and Tool Chest
Ex. hood
Ventilators and Radiators
Recessed Shelving Bulletin board or desk

Plan 2. A Science Laboratory for a Small School a/.

a/ The floor plan on this page has been adapted by the writer.

teachers as a necessity if the unit method of instruction is to be employed. Bulletin board, display case, and bookcase areas are small, but possibly adequate. Other space may be utilized for these. The room is designed to allow for the introduction of a general course in physical science.

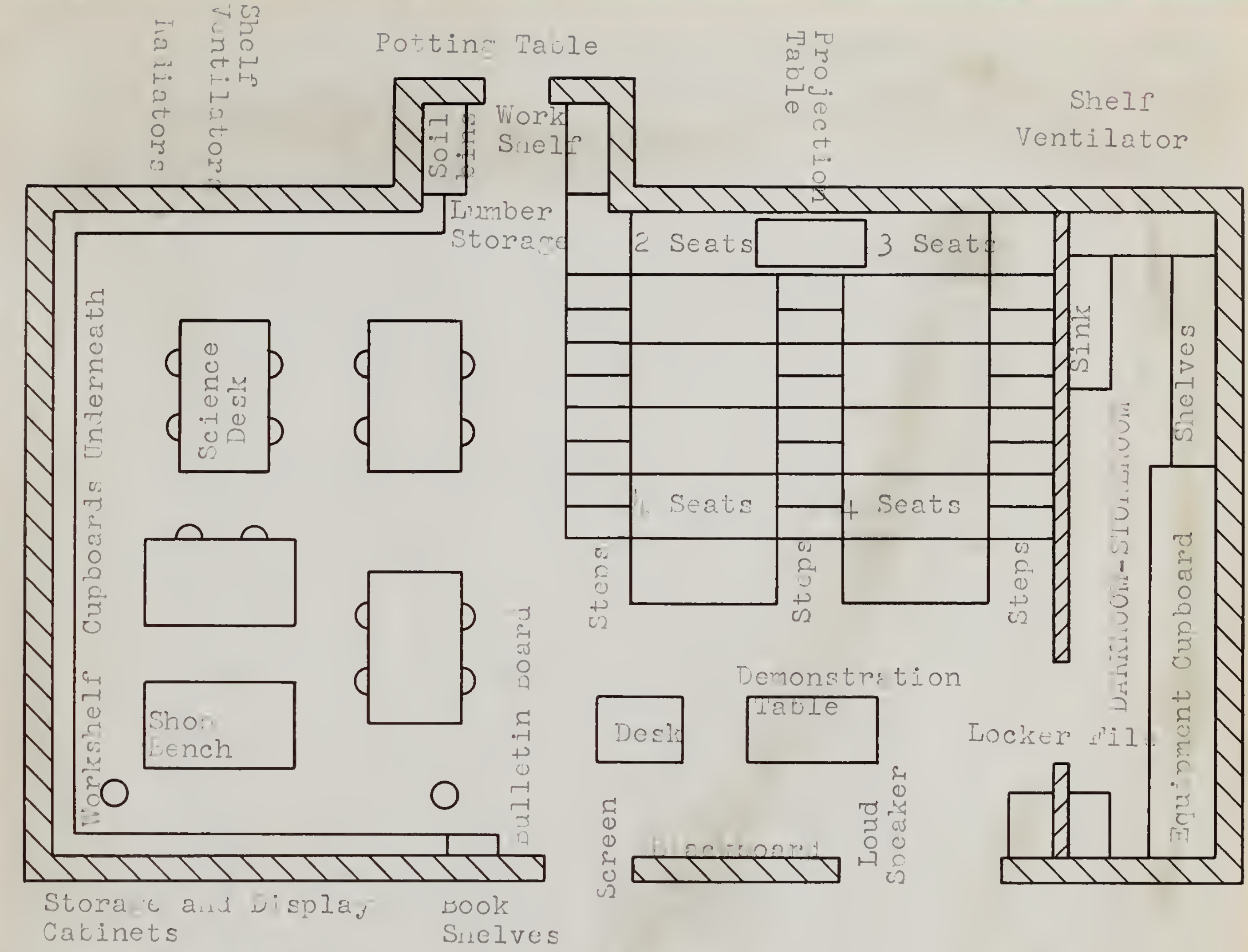
Victor D. Smith[1].

> "The accompanying floor plan[2] is one designed to solve better than the usual designs the unique problems of science teaching. It accommodates 45 pupils in the fixed seats, and 30 of these pupils may find additional stations for activities at one time at the science tables, potting table, shelves, storeroom sink, shop bench, and in other work areas. It provides an all-over-per-pupil area of 25 feet per pupil, including the auditorium seating, for 45 pupils. In a six-period day it can accommodate a maximum of 270 pupils.
>
> The special merit of this plan is that it offers closed seating for recitation, visual instruction, necessary lectures, demonstrations, and other work which must be closely shared and co-ordinated for all pupils. In addition, it permits dispersal of many of the pupils for activities, reading, testing, and club work or special classes.
>
> Following is detail listing of special features of this classroom:
>
> Orientation: This classroom, 25 by 45 feet is located on the ground floor and has direct access out of doors through the hall containing soil bins, and potting and work areas. It preferably opens into an enclosed area in which weather instruments, garden

---

[1] Op. cit., p. 47-48.

[2] Plan 3 page 39.


Radiators
Shelf Ventilators
Potting Table
Soil Bins
Work Shelf
Lumber Storage
Projection Table
Shelf Ventilator
2 Seats
3 Seats
Science Desk
Workshelf Cupboards Underneath
Sink
Shelves
4 Seats
4 Seats
Steps
Steps
Steps
Darkroom-Storeroom
Equipment Cupboard
Demonstration Table
Desk
Locker File
Shop Bench
Bulletin Board
Screen
Blackboard
Loud Speaker
Storage and Display Cabinets
Book Shelves

Size: 25x45 feet
Seating Capacity: 45 plus 30
Per Pupil Area 25 Square feet

Plan 3. A Science Room with Activity and Closed Seat Arrangement. a/

a/ The floor plan on this page has been adapted by the writer.

plots, and outdoor animal cages are located. This outdoor area must not be on the north side of the building, and in northern climates it should be on the south side.

Closed seating: The five rows of eight auditorium-type seats each, with five additional seats near the projection table provide space for 45 pupils. In emergency situations, additional seating is available on the steps. By placement of the aisles, no pupil must pass before more than one other pupil to be seated. Chairs should be equipped with hinged tablet arms.

Demonstration equipment: A standard black-or stone-topped desk with gas, sink and water, physical supports, electrical outlets, and storage space is indicated. The teacher's desk is beside the demonstration table. Easy access to the storeroom is possible... .

Sound and projection equipment: The screen and loud-speaker are behind the demonstration desk. Either a commercial screen or a painted-on-the-wall white screen should be provided. The loud-speaker should be permanently wired to the projector, and may be made to serve a double purpose by connecting it with a throw switch to a radio and the general sound apparatus. The projection table should be equipped with outlets for motion picture and still projectors. A microphone for teacher's use can be provided if desired.

Activity area: The three large science tables are the usual four-place tables, fitted with sink, gas, and a protected 110-volt electrical outlet. The other table is a two-place table similarly equipped. The shop bench is the standard woodworking bench with wood and metal vises, anvil, soldering iron outlet, and other equipment. The bookcase and magazine rack are easily accessible from the activity area. The work shelf extending around two sides of this area should be of heavy wood or stone, finished to resist water, ordinary chemicals and soiling.

Entryway and outdoor laboratory: The entryway provides a small area outside the room for handling soil, flowerpots, animals, and other materials which soil and damage ordinary working surfaces. A faucet and hose connection should be provided. The potting table should have a sheet-metal top, and a rail about three inches high to prevent soil from falling to the floor. Animal cages are best kept in this entryway to avoid odors and disturbance of the animals. The outdoor laboratory should be fenced with strong steelmesh wire set on steel posts in concrete, and should have a gate which can be locked. A standard housing box for weather instruments is desirable.

Storage: Demonstration equipment may be stored in the demonstration desk and in the storeroom equipment cupboards. Materials and equipment for pupil activities may be stored in the cabinets beneath the work shelves and in the wall cases. These cases should not be locked, but merely supervised. Lumber and other heavy materials may be stored beneath the raised seats of the auditorium seating area. The science tables provide storage for small equipment such as burners, stands, and glassware... .

Chromium or other metal chairs, with bright-colored plasticized fabric seats are probably as durable, and certainly more comfortable and attractive than old-fashioned laboratory stools. At least 16 such chairs are needed.

It is worthwhile to experiment with light-colored plastics or linoleum for science and demonstration table tops. Such tops can be replaced rather cheaply and break the tradition of dreariness... .

Storeroom and darkroom: The serving of a multiple purpose is again illustrated. The same sink which is useful for washing of equipment and making of preparations can serve as part of the darkroom equipment. The shelves provide working area both for handling equipment and loading film tanks, placing trays, etc. Fluorescent fixtures in this room provide required

light. The teacher's test and catalog file is placed in this room. This darkroom is not intended for photographic printing and enlarging, but only for handling film. With photography classes now running into standard class size, most work will be carried on in the darkened activity area in the classroom.

Heating and Ventilation: Only mechanical ventilation is satisfactory in a science classroom. Open windows make control of light, flames, and insect pests impossible. Heat should be thermostatically controlled. All ventilation openings should be adequately light trapped.

Special Equipment: It is desirable to equip the clock with a large second hand.

The small high school might as well adapt this plan to provide for all science merely by providing a somewhat larger activity area, and by reducing the number of auditorium seats. Even where economy is essential, this general plan is still practical. Movable armchairs may be substituted for the auditorium seats, and an activity area provided in the space made available by rearrangement of the tables or seats. The essential merit of the plan is not only in the exact details shown, but also in the division of the space of the room to serve best the two types of needs of the general science program. These are to provide: (1) an area of closed seating for demonstration, visual instruction, recitation, and lectures; and (2) an open area for pupil activities for dispersal of the pupils for study, tests and individual work. Equipping the room to serve special purposes, such as photography is optional."

Comments. -- Smith recommends the building of this room without windows because of the effect that open windows have upon gas flames and exact experimentation. He does, however, say that windows may be put in the wall on the side of the room which contains the potting room.

This writer would greatly prefer a room with windows to one without. The reasons for this are that a room with windows is more pleasant, that general science is not an exact science, that the windows may be closed or need not even be opened if adequate mechanical ventilation is provided, and that blackout shades may easily be installed to provide for darkening the room whenever necessary. A room of this type should prove to be very adequate for instruction in general science in the lower secondary grades and can easily be adapted for the teaching of the more advanced courses in science.

Vierling Kersey[1].

> "The type of laboratory that has been developed in the Los Angeles high schools is usable for classes in biology, physiology, botany, general science or recitation in other subjects. The dimensions are 23 by 45 feet including 7 feet for storerooms. Such rooms are built in pairs, with a common storeroom between, in which case it is usually possible to devote more space to classroom purposes.
>
> The propagating tables are in the rear of the room and at the side next to the windows with the aquarium near the front of the room. Each pupil table is planned for two pupils making a total capacity of 36. The pupil tables, which measure 2 by 5 feet with the top 30 inches from the floor, are equipped with gas outlets and are arranged for both laboratory work and recitation. The demonstration table in the front of the room is provided with a sink, gas, and electric outlets; it is divided into two parts, so that one

---

[1] Vierling Kersey, "Needed Flexibility," Nation's Schools, 26:36-46, (July 1940).

portion can be wheeled into the storeroom for stocking or returning supplies. Except for the demonstration table, the only sinks provided are in the rear of the room.

Electric outlets are provided at both the front and rear of the room for projection and radio. The general science room, as provided in junior high schools or six year schools, where such rooms are necessary, is a simplified form of biology laboratory.

The physics laboratory follows closely the general plan of the biology laboratory and is adapted for classes in physics, advanced science, general science or classroom recitation in any subject. More storage space is needed for apparatus but the classroom space is the same and the type of table is similar to that used for biology. A dark room and I-beam for suspension are two features not found in the other laboratories.

Physics tables are equipped with electrical outlets providing both direct and alternating currents at various voltages. The switchboard is designed to offer a wide range of applications in a compact space at a reasonable cost. The board is approximately 30 inches wide, 64½ inches high and 20 inches deep. It may be installed through a wall or may be free standing. In either case the rear of the board is enclosed in wire mesh so that individual items of equipment and the wiring system may be studied.

The equipment includes one motor-generator set (1/3 h.p.) with field rheostat to produce voltage from approximately 15 to 125 volts. Five voltage selector dial switches for D. C. circuits on instructor's and pupil tables give voltage from 2.4 to 12.0. A 10 cell storage battery with a dry plate battery charger provides the direct current. A panel and six circuits supply alternating current to each pupil table.

Two methods of obtaining flexibility in the chemistry laboratory are possible. In working out an entirely new plant, it would probably be preferable to install a type of equipment that would make

> it possible to use the entire room for recitation. In an extensive program of rebuilding, it has been necessary to conserve existing equipment, which in a chemistry laboratory represents a large fraction of the total cost of the unit. It has proved possible and practical to use the older type of table and to provide for a compact recitation space at the end of the room. By placing tables slightly closer together, this adjustment is made without materially increasing the total length of the room. One of the newer rooms so equipped takes the place of two rooms in older buildings. The dimensions of the room are 23 by 48 feet, including the stockroom and office with facilities for 36 pupils as a maximum... .
>
> Flexibility cannot be accomplished by mechanical devices for easy and inexpensive alterations. It is achieved rather through developing a room suited to a wide range of uses. It depends to a considerable extent on the size of the room, for a small room permits little variation in use.
>
> In older organization, classes in natural science are usually scheduled for three days of presentation and two days of laboratory work. If the laboratory experiment assigned for the day was short, time was wasted. If it was too long to be completed, several days might elapse before work could be continued. With the present laboratory setup, it is possible to change quickly from demonstration to laboratory work if the educational system demands it. Since explanation and experimentation can be really integrated, the new type of laboratory has done much to promote learning."

Comments. -- Kersey deals with the problems of the schools of Los Angeles. In some cases they are designing new classrooms and, in other instances, they are redesigning existing rooms. Their laboratories are designed for biology, general science, physics and chemistry, but in most instances they are so designed that they may be used

for more than one subject. Because of the introduction of an advanced science course there seems to be some tendency to design classrooms that will meet the needs of the new organization of science courses. It is very apparent that a science room meeting the needs of a modern educational program must possess the flexibility which Kersey stresses. Floor plans[1] of two of the science rooms which are being used in Los Angeles appear on the following pages.

National Society for the Study of Education[2].

Planning the Science Room[3]

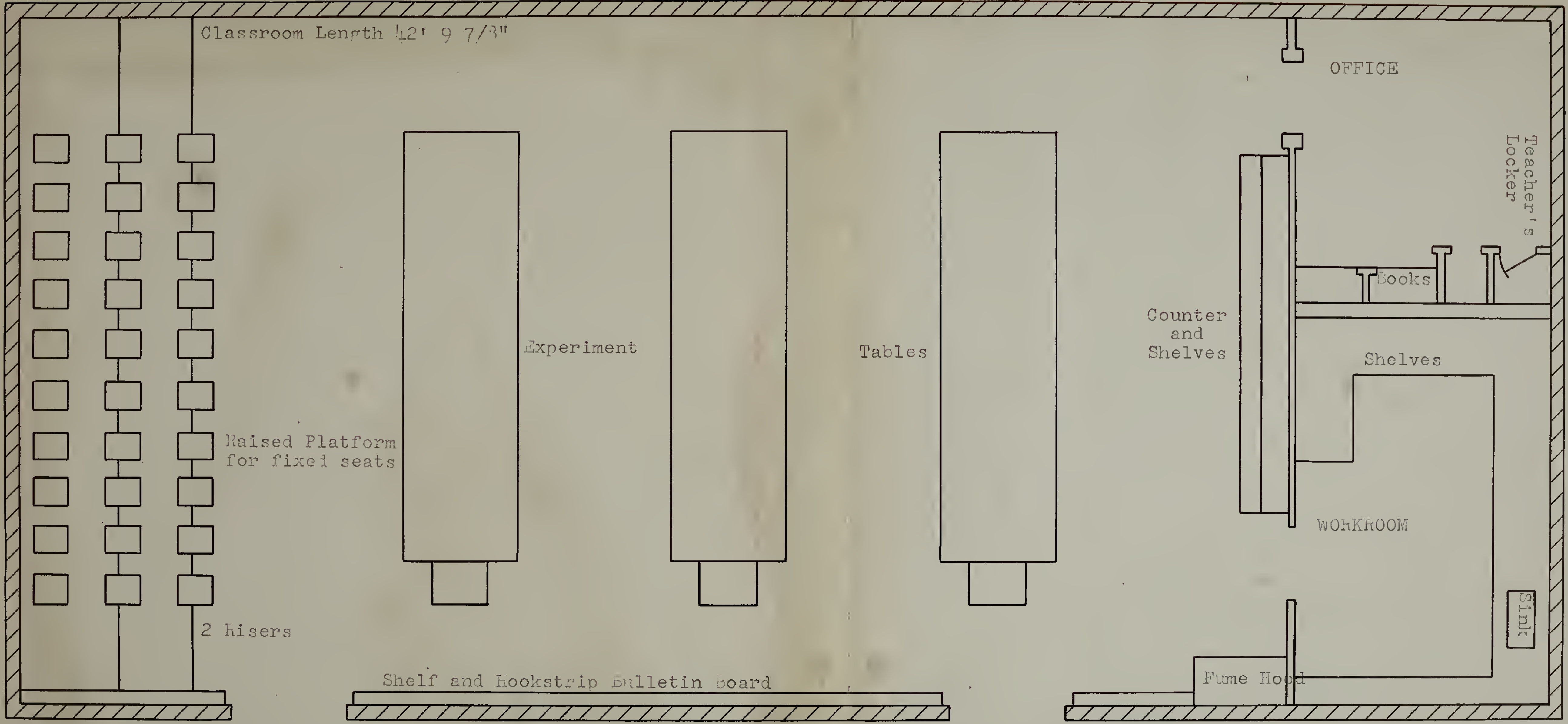
> Ideally a science room should be planned as a place where students may carry on all the science activities that contribute to the objectives of science instruction. This means that a science room should be equipped for general classroom activities, demonstration work, and laboratory work. Such a room will make it possible for teachers and pupils to change quickly from one type of activity to another and thereby provide better co-ordination between all science activities. Such a plan will also eliminate the economic losses that are encountered when science laboratories are separated from the science classrooms.

---

[1] Plan 4, p. 47, Plan 5, p. 48.

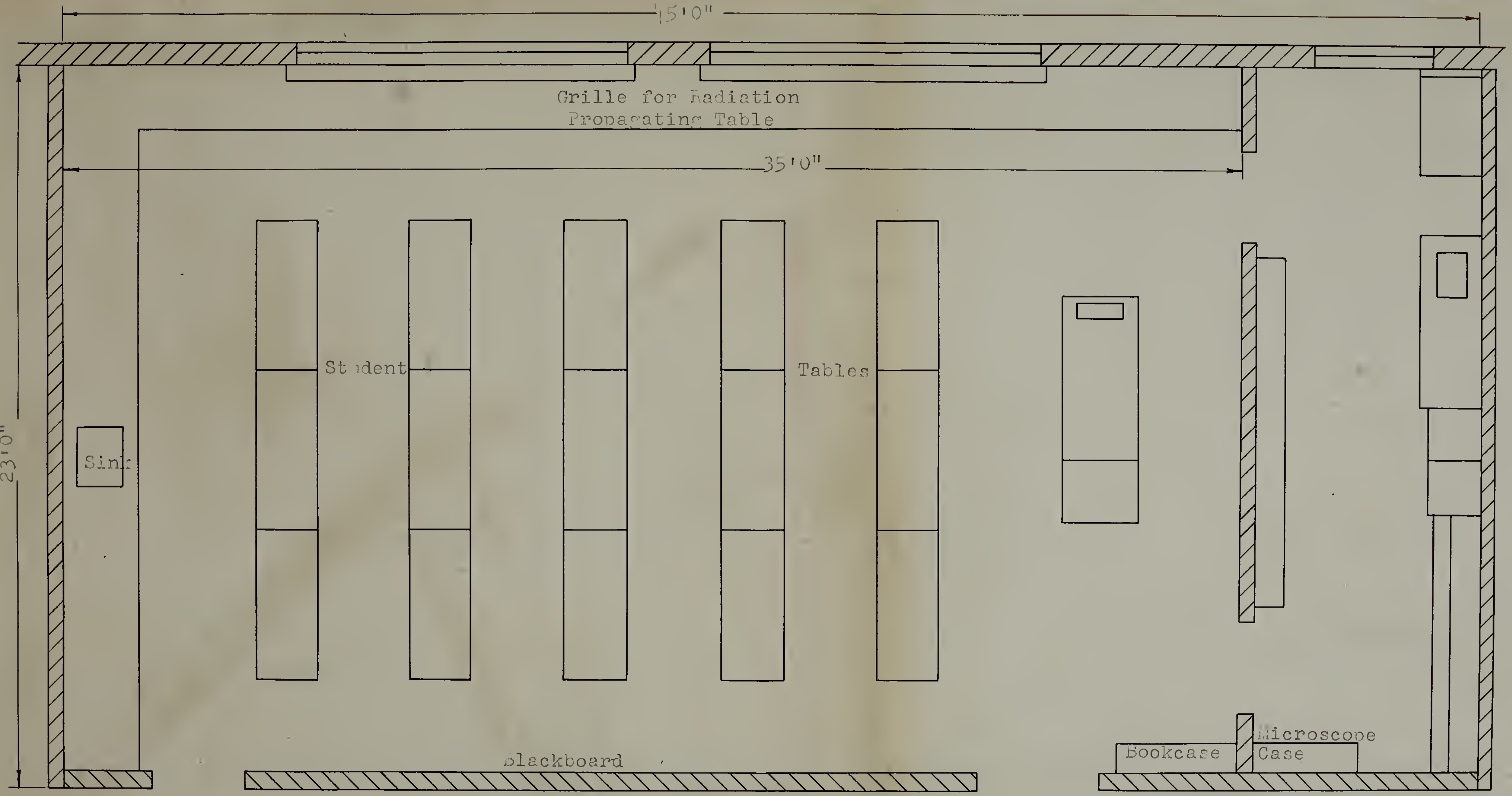
[2] National Society for the Study of Education, Science Education in American Schools, Forty-sixth Yearbook, Part I, National Society for the Study of Education, Chicago, Illinois, 1947, p. 240-242.

[3] The committee has profited from the collaboration of Elwood D. Heiss, State Teachers College, New Haven, Connecticut, in the preparation of this section.


Classroom Length 42' 9 7/8"
OFFICE
Teacher's Locker
Books
Counter and Shelves
Shelves
Experiment
Tables
Raised Platform for fixed seats
WORKROOM
Sink
2 Risers
Shelf and Hookstrip Bulletin Board
Fume Hood

Plan 4. A Chemistry Laboratory with Recitation Space for 36 Pupils a/.

a/ The floor plan on this page has been adapted by the writer.


15'0"
Grille for Radiation
Propagating Table
35'0"
23'0"
Sink
Student
Tables
Blackboard
Bookcase
Microscope
Case

Plan 5. Biology or Life Science Laboratory a/

a/ The floor plan on this page has been adapted by the writer.

Size of science rooms. There is at present no scientifically standardized size for a science room. Science rooms will obviously differ considerably in size depending upon the number of pupils to be accommodated. For an efficient science program, in justice to both pupils and teacher, the laboratory class should not exceed twenty pupils. Where classroom work other than individual laboratory work by pupils is conducted, a room sufficiently large to accommodate thirty pupils may be used.

It is highly desirable, when a new school building is to be built, that the science staff, the school administrators, and the architect work together in planning the details of the science room.

Laboratory furniture. A large instructor's demonstration table (8 to 12 feet in length) should be centered in the front of the science room. This should be equipped with running water, a sink, and gas and electrical outlets. It should have an acid-resistant top and drawer space for items needed in demonstrations. Properly designed cupboards should be provided for regular storage of materials and equipment.

Several different plans may be used to provide accommodations for laboratory work. One plan is to provide about thirty arm-table chairs in the front of the room facing the demonstration table. Back of the chairs are placed laboratory tables. Movable stools with rubber tips are provided if pupils sit down when doing experiments. Another plan is to equip the room with special-type laboratory tables, such as the Lincoln desk, which permit the pupils either to sit or stand when doing experiments or when they are participating in demonstration-recitation lessons.

Experience has shown that it is more economical to equip a science room with the very best materials. Laboratory furniture bought from reputable manufacturers is usually better than the homemade variety. The plumbing fixtures should be brass or copper, chromium plated, and made for long, hard service. Laboratory sinks should be made of

or lined with soapstone. Plenty of drawer space should be available in the laboratory tables.

Cabinets and chart cases. A wide variety of objects, specimens, and models are used in teaching science. Cases and cabinets for display and storage of these materials are necessary in the science room. Storage and display cabinets should be equipped with rolling doors that move freely on steel tracks. Adjustable shelves are also helpful. An exhibition case for displaying completed student projects is an excellent motivating device in a science room. A notebook cabinet in which the pupils may place their records of completed projects and experiments is also useful.

Since both homemade and commercial wall charts are being widely used to give a clearer meaning to the ideas of science, a chart case or a rack with rollers is very desirable.

Provisions for use of visual aids. Motion-picture, slide, opaque, and micro-projectors are used in teaching science. Special care must be taken with the windows so that the science room may be easily and quickly darkened. Boxed-in opaque window shades are generally considered best for this purpose. Proper screens, both daylight and reflecting, are required equipment. Electrical outlets must be conveniently placed in the room.

Bulletin and blackboard. Every science room needs a large permanent bulletin board. Its uses are many. Photographs, diagrams, and clippings may be posted on it. It may be used as a place to exhibit exceptional work done by pupils. It is an excellent place to post assignments and notices.

A bulletin board may be made by tacking a piece of plain green denim over smooth pine or a piece of Celotex. Bulletin boards may also be made from Compoboard. A frame around the board will make it more attractive.

Blackboards should be provided along the front

> and at least a part of one side of the science room.
>
> Aquariums, terrariums, and receptacles for growing plants. Space should be provided for aquariums and terrariums in a science room that is to be used for teaching general science or biology. Receptacles such as window boxes for growing plants may also be desirable.
>
> Stockroom and darkroom. The stockroom should be large enough to provide adequate space for storage. It should also provide enough room for the preparation of solutions and demonstration setups. Cases or cupboards containing a large number of drawers and shelves will provide a space for everything that is necessary. A sink with running water should also be provided.
>
> A darkroom should be planned as an adjunct to the science classroom. It is important for experiments in optics and photography in physics and chemistry. It may also be used for certain experiments in general science and biology, such as those dealing with plant growth and tropisms."

Comments. -- This room is designed to meet the needs of a school that is planning a modern educational program in the sciences. It provides flexibility, storage, display, and blackboard space, and space for experimentation with growing plants and animals. All of the activities of the pupils in science can take place in either the large room or the smaller storeroom-darkroom.

C. G. Campbell[1].

> "Today the average secondary-school chemistry laboratory will provide each student with individual drawer and cupboard space, individual scien-

---

[1] C. G. Campbell, "Scientific Laboratory Furniture During the Past 50 years," American School Board Journal, 100:44-45, (March 1940).

tific apparatus, adequate working surfaces to permit him to carry on personally, or, in any event, in groups not larger than four, all of the experiments prescribed in the modern course of study, and will place for his convenient use hot and cold running water, gas and a. c. and d. c. electricity, and often, in addition to these services, compressed air, vacuum, and steam outlets. Further, each student or small group of students has drainage in the form of troughs or sinks, or both, conveniently available, while properly designed fume hoods and adequate mechanical ventilation so thoroughly remove obnoxious fumes and gases that the modern chemistry laboratory becomes as pleasant and healthful a place in which to work as any department in the school.

Modern laboratory furniture for the chemistry laboratory utilizes many materials which did not exist fifty or even twenty years ago. Thoroughly waterproof plywood has combined complete resistance to water, and greatly added strength, with a distinct saving in bulk and a definite increase in net storage capacity in a given piece of laboratory furniture. The use of waterproof plywood has permitted the construction of furniture having flush exterior surfaces that can be easily maintained in a state of cleanliness. Impregnated fiber drawer and cupboard bottoms have been provided that offer protection against chemical accidents. Lead-coated alloyed-steel drawer runs provide smooth and jarless drawer operation. Plywood drawer heads and doors eliminate binding and rattling from expansion and contraction of the wood with seasonal changes. Laminated table tops of impregnated fiber material eliminate the opening of joints in table tops and provide quite comfortable working surfaces. Chemical-resistant, metal-reinforced, plastic hardware eliminates hardware tarnish and corrosion under laboratory conditions. Acid, alkali, and solvent-resisting baking enamels and spraying lacquers protect table tops and cabinet bodies from unsightly marring due to accidents that are inevitable in laboratory work.

Corrosion-resistant alloy steel, coated

> with lead and further protected with highly acid, alkali, and solvent-resisting high-bake enamels, have made available laboratory furniture of all-metal construction that offers marvelous protection against corrosion in the laboratory and provides added protection against fire. Impregnated asbestos materials provide corrosion-resistant, fireproof fume hoods, that are extremely attractive and will function with a minimum of maintenance. Attractiveness of design is an important consideration in the manufacture of present-day laboratory furniture, and the development of the roll-edge, flush exteriors, used in the better, modern laboratory furniture has provided dignity and attractiveness that adds much to the appearance of the laboratory."

Comments. -- The improvement of furniture for a chemistry laboratory is discussed by the President and Manager of Kewaunee Manufacturing Company. Although the article deals specifically with chemistry, a great deal of the reasoning can be applied when furnishing any appropriate science room.

National Council on Schoolhouse Construction[1].

> "Three types of science facilities have been used extensively; (1) separate rooms for demonstration and lecture work and for pupil experimentation and laboratory work; (2) a laboratory in which one area of the room is equipped with seats and a demonstration desk for recitation, lecture, and teacher demonstration and another area of the same room is equipped for pupil experimentation; and (3) a laboratory equipped with one-way facing science tables so that each pupil-station may be used for recitation, lecture, demonstration and pupil experimentation for all the usual science activities. Type three conserves space, makes programming easier, and is usually preferable.

---

[1] Op. cit., p. 83-84.

Each science laboratory should satisfy at least minimum classroom standards for heat, light, and ventilation. Chemical laboratories should also be provided with special ventilation for the removal of gases and fumes. In laboratories where acids are used, acid-resistant table tops, sinks, and soil lines are essential.

The floor area required must be determined from consideration of the type of laboratory selected and the class size contemplated. It is suggested that a minimum of 30 square feet net per pupil is needed in science laboratories exclusive of storage and other accessory space.

The instructor's desk should be equipped with sink, water supply, drain, gas connections, electric outlets, upright rods with clamps, and such other fittings as may be required for the specific science program. The services needed on student laboratory tables will depend upon the sciences taught in the laboratory and the type of pupil experimentation to be conducted. Services and fittings similar to those recommended for the instructor's desk should be easily accessible to each pupil working station if the laboratory is to serve for all of the regular high school sciences. Most of these services and fittings are desirable for any one of the science subjects, but often are omitted at individual student stations used exclusively for general science and biology if available in the laboratory for general use. Although desirable, individual water supply and drain are not essential for physics.

In planning science laboratories, it is essential that the type of equipment and services be determined in time to provide the necessary floor and wall connections at the proper locations during basic construction.

There should be adequate storage space for general equipment and supplies, for pupils' notebooks, and for other individual materials. Chemical storage should be designed with special ventilation, should be fire-resistive, and should be separate from the storage space for apparatus and other supplies. In small high schools, the

> chemical storeroom, if equipped with a sink, may also serve as a dark-room for photography. A minimum of 125 square feet of floor area suitably arranged and utilized should be provided for storage for a science laboratory. When two science laboratories are serviced by storage rooms between them, a minimum of 150 square feet of floor area is needed.
>
> Schools having a broad program of special activities including extensive work in photography may require a photographic laboratory. Such a laboratory should be designed especially for photography and it should include adequate dark-room facilities. In some schools a small special laboratory is justified for the use of the instructor or a select group of students for special experiments which cannot be conducted feasibly in the other laboratories. This laboratory should be equipped with gas, water, electric service, and such other facilities as may be required."

Comments. -- This article summarizes the characteristics of good science rooms. No specific arrangement of any one room is mentioned. The teaching procedure to be used has not been discussed. If the use of the room is limited to one subject of science study, it will not require all of the provisions needed if it is to be used for the instruction of several sciences. In an evaluation of the three types of seating facilities the one-way facing science table is recommended over closed seating with a different activity area in the same room and separate rooms for recitation and experimentation.

Annotated bibliography. -- The annotated bibliography below is given to aid interested readers in locating

other literature regarding the science classroom.

Dolloff and others, "Facilities for Correlated Work in the Sciences and Arts," *American School and University, Fifteenth Annual Edition*, American School Publishing Corporation, New York, 1943, p. 193-195. The use of a suite of rooms for physics, chemistry, biology, general science, general shop, mechanical arts, and fine arts is described. Floor plans are given.

Eckles, W. G., "The Question of Equipment," *Nation's Schools*, 26:40-41 (July 1940). A laboratory must accommodate not only high school courses in biology, physics, chemistry, and general science, but also laboratory work in agriculture and possibly other subjects. A floor plan is given.

Graham, C. C., "Some Science Material and Teaching Aids for Secondary Science." *Educational Administration and Supervision*, 27:420-426 (September 1941). The title is self-explanatory.

Greene, C. W., "Master Lists and Storage of Equipment Used in High School Courses," *American School Board Journal*, 112:51-53, January: 35-39, February: 33-36, April: 39-40, May: 113:34-36, September: 47-48, November: 48-49, December 1946. A complete list of equipment and supplies needed for classes of varying size in different science courses is presented.

Gunn, T. F., "Setup for Science," *Nation's Schools*, 26: 38-39 (July 1940). Division of classes for college and non-college preparatory students in Detroit is explained as well as the number of facilities available.

Holmes, Warren, "Biology Rooms at Lansing," *Nation's Schools*, 26:42-43 (July 1940). No plans are given, but a description for a biology setup is fairly complete.

Leib, F. I., "Desigred for the Small School," *Nation's Schools*, 26:44 (July 1940). A floor plan for a suite of rooms to include a darkroom, a workroom, and a combined lecture room and laboratory is given.

Rolfe, Stanley, H., "Science in a Senior High," *Nation's Schools*, 26:45-46 (July 1940). In West Side High

School, Newark, New Jersey, the lecture rooms and laboratory rooms are separate rooms. This enables the teachers to teach an extra period each day through the use of laboratory assistants.

Zaph, Rosalind M., "Classrooms as a Means of Stimulating Interest in Science," Science Education, 23:206-209 (April 1939). This article gives a list of methods and of equipment needed for the stimulating of science at the junior-high-school level.

Essential Features of a Good Science Laboratory

Conclusions. -- The laboratories of a small and a large high school vary considerably. The small school must confine most of its science activity to one room, but if the complete reorganization of the science courses were to take place, this room would be better adapted to these changed courses than the specialized laboratories of many of the larger high schools. To be flexible a science laboratory should be constructed to accommodate the instruction of more than one science.

There is undoubtedly no one type of laboratory which will best serve the needs of a large number of schools. The above-mentioned articles have given a large number of features which the writers feel are necessary to meet the needs of science education. They show a tendency toward planning for the most part to meet the needs of the general science, biology, chemistry, and physics curricula, but some consideration is being given to the more generalized needs of the biological and

physical sequences. Although many of these plans mention the matter of bookcases, there is none which points out the extreme importance of the classroom library. To this writer it seems that a science classroom library in a modern school should contain a large quantity of science magazines and selected books on science.

The classroom which makes provision for demonstration, recitation, testing, and experimentation in all of the sciences would seem to be the most desirable if the unit plan of teaching is used. Flexible use of a suite of rooms might also meet the requirements of the program.

Equipment. -- No attempt has been made by the writer to make a list of the equipment needs in a good science laboratory as was the case for a mathematics classroom. Most science teachers are well acquainted with the amount of kinds of laboratory equipment to meet their needs. For those interested, several references regarding equipment are given in the annotated bibliography preceding this section.

Working space. -- The amount of needed working space varies according to the use of the room. The type of work space will also vary, but in the more advanced science courses, the tables should be supplied with water, electricity (a.c. and d.c.), and gas outlets as

well as have access to sinks for drainage. It is possible that these tables may be furnished with compressed air, steam, and vacuum outlets. If acids are used at the tables, the tops should be acid-resistant. The tables should also be supplied with removable supports for physical science experimentation. Cupboards and drawers will be in all work tables for use as storage. Less interference occurs if students work on only one side of the table. A demonstration table should be one of the features of the rooms. One section of the table may be on wheels if the storeroom is at some distance from it.

Student seating. -- The literature suggests three types of seating: movable arm chairs, combination experiment - writing desk, and a fixed tier of seats. All have their advantages and disadvantages. The movable arm chair allows for greater flexibility of the room. The combination experiment - writing desk conserves space and gives greater utility but provides poor view for demonstration observations. The fixed tier of seats takes up a space that can be used only for seating and study but gives better view in observation of demonstration work.

Display space. -- Blackboard space must be provided in front of the seats and possibly on part of one side

wall. All possible space should be provided for bulletin boards. Display cases should be supplied for exhibition purposes.

Storage space. -- Storeroom or combination storeroom-darkroom should be provided, as well as wall cupboards for storage in the main room, storage facilities for wall charts, and a file case.

Library provisions. -- Bookcase and magazine rack or, if a suite of rooms, one room for a science reading room should be provided.

Provisions for audio-visual aids. -- The room must be easily darkened, a screen provided in the front of the room and electrical outlets near the projection table.

Terrariums, aquariums, and growing tables should be placed in all science rooms where the nature of growth is studied.

Safety provisions. -- Exhaust hoods should be in all rooms where gases are generated.

Fire extinguishers and first aid equipment should be available.

Other provisions. -- Outdoor laboratory, animal cages.

CHAPTER IV

THE ENGLISH CLASSROOM

The Changing Design of the English Classroom

The English classroom of the traditional high school. In the past, the design of an English classroom was little different from that of any other classroom. There may have been a bookcase partly filled with select novels, plays, essays, and poetry to distinguish it from other classrooms, but very often it would not contain even the solitary book case. The fact that many periods of English were taught in most schools meant that occasionally certain rooms would be designated as English classrooms and used only for English instruction. This meant that English teachers, so inclined, had an opportunity to create an atmosphere for teaching their subject. Even with this advantage some were so overcome by the importance of their subject in the school program that they were not concerned with making the room or the subject appealing, interesting, or functional.

The new English curriculum. -- In recent years, extensive reading has replaced the emphasis on intensive reading in high-school English courses. This has necessi-

tated the use of many more books in the English classroom. The emphasis on the needs of the individual pupils in oral and written expression and the attempt to make all teaching functional through integration with other subjects have led to a new teaching approach to English. The reorganized English curriculum placed in the hands of competent teachers using the unit method of teaching necessitates a modern classroom. On this subject Dr. Roy O. Billett[1], Professor of Education at Boston University, said, "A completely modern program of English instruction is not possible in the traditional classroom, traditionally equipped."

Recommendations for English Classrooms

Letta M. Clark[2].

> "The English workroom or the English laboratory is of great importance in any school; but, if English is anything more than mechanical drill, the room must be much more than that. The storage of tests and supplies, the assembly of books and magazines, and equipment for comfortable reading and writing do not call for a bare and colorless background.
>
> In our own case the beginnings had to be made in a small way, the equipment added bit by bit; yet our satisfaction and increased opportunities have been out of all proportion to the cost. A cork bulletin board across one wall has allowed for the display of poetry broadsides, of prints, of contemporary paintings, and display arranged by individual teachers or

---

[1] Roy O. Billett, Fundamentals of Secondary School Teaching, Houghton-Mifflin Company, Boston, 1940, p. 212.

[2] Letta M. Clark, "Room of Her Own," English Journal, 30: 148-149 (February 1941).

> pupils. Two bookcases hold the necessary literature and pedagogical references; a cupboard hides from view the less attractive outlines, drill sheets, charts, and other necessary supplies. A second-hand phonograph -- which cost us little -- enables us to enjoy the Orson Welles records for the _Merchant of Venice_ or Robert Frost's or Vachel Lindsay's readings of his own poems. A radio can be plugged in for the 'School of the Air' programs.
>
> Now and then, a student whose interests are manual rather than literary makes us a gift of some charming small specimen of his handiwork that seems to him to have value in an English workroom -- soap carvings, tiny ship models, a model airplane, a finely proportioned covered wagon. It is difficult to tell whose pleasure is greater, that of the maker or of his admiring audience."

Comments. -- A classroom teacher here presents an actual situation in which a traditional classroom was transformed into an English laboratory or workroom. This room is comparatively inexpensive. The conversion was gradual and it suggested participation by the pupils. Attractiveness and comfort were considered. No classroom procedure is given as being used in the room.

Change of this type is particularly effective when a teacher has a room of her own and wishes for improvement. This room seems especially adequate for the reading and writing phases of English, but no mention is made of provisions for oral English such as a lectern, sound-recording apparatus, and a stage.

Dora V. Smith[1].

> "An outstanding school in Group II has a model classroom in English used for supervisory purposes as an illustration of what may be done to create an English laboratory. Across the front of the room above the blackboard is the series of the Library of Congress pictures representing the 'Making of a Book'. On a burlap freeze below, another series of pictures illustrates the Idylls of the King. At the back is a cabinet across the center of the room with large, shallow drawers for filing papers and illustrative materials. On top of it is a dictionary, and in front of it a table for reference work. To the right near the door a large bulletin board displays a picture map of English literature along with other literary illustrations. Pupil desks occupy the middle and left-hand side of the room. The right-hand side is furnished with a large, open-shelved, well-filled book-case near the front, in the center a long cabinet and closed-in case for displaying pupil creative work, and toward the back a broad bulletin board for pasting current events in literature and the fine arts, the theater, the radio, and the motion picture. Two vases of flowers add to the attractiveness of the room. It is a place for sharing both literature and experience. Not every school, of course, could afford such a room; but its various offerings are described here that teachers with barren classrooms may perhaps find in it a suggestion of directions in which they may move in transforming their classrooms into laboratories for reading, writing, and speaking."

Comments. -- The classroom described above is selected from a study of the English classes of fifty-one high schools in New York State. It was considered by

---

[1] Dora V. Smith, "Evaluating Instruction in Secondary School English," English Monograph, No. 11, National Council of Teachers of English, Chicago, 1941, p. 140.

Smith as being one of the most ideal encountered in her study. It was not used as a regular classroom, but was used for supervisory and experimental purposes. Comfort and a homelike atmosphere were important considerations in the planning of this room. A great deal of display and storage space is provided.

Smith indicates that this room should provide a source of suggestions for teachers who wish to transfer their classrooms into laboratories for reading, writing, and speaking. There seems to be little equipment that provides particularly for the oral phase of English. Sound-producing and sound-recording apparatus and a stage are features which should be added to this room.

W. H. Johnson[1].

> "Reference has previously been made to the fact that the high school English laboratory in Chicago was proposed by committees of teachers engaged in the revision of their curriculum. But just how did it evolve? Assigned to the four areas into which the English work was divided, the committees were charged with the preparation of five units for each of the required six semesters of English. As they approached the job of planning in detail the content, activity, and methodology of each of the areas, their needs became apparent. Suggestions regarding the most imperative of these began pouring in to the executive committee in charge of the revision project. First, the committee producing units in the area of communication insisted upon its needs: a conference table and eight chairs, movable seats, recording and play-back apparatus, a lectern, a mock broadcasting radio outfit if

---

[1] W. H. Johnson, "High School English Laboratory," American School Board Journal, 106:31-33(January 1943).

the real thing could not be procured, a wide selection of recordings, and a number of blank records. Second the literary heritage committee made its wants known: an extensive selection of books for a classroom library, adequate shelving and storage space, tote boxes for carrying the books back to the bookroom periodically in exchange for new collections, cabinets for filing the cumulative reading records, files for room library catalog cards. Third, came the demands for the producers of the current-English area: a magazine rack, adequate bulletin board space, a table on which newspapers and magazines could be spread to facilitate their reading, duplicating devices for getting out notices about recommended radio programs and movies. And finally requests were submitted by the committee developing units dealing with certain important aspects of general education for which the English department is now assuming responsibility in the Chicago high school. Fortunately, most of the needs of this group were identical with those of the other committees.

The accompanying floor plan1/ of the new Chicago high school English laboratory shows the layout. The plan is tentative, for the committee still have a year or two of work ahead of them before the new curriculum will be complete. Doubtless further needs will become apparent as the work proceeds, and the specifications for the new equipment may have to be changed as a result of experience. For example, the laboratories are now equipped with 35 movable seats. Although these make possible all sorts of patterns of seating for student groups engaged in various types of activity, some of the teachers are already questioning them. They wonder whether or not about twenty fixed seats supplemented by a dozen tablet-arm chairs, plus a couple of small conference tables seated with bent wood chairs would not be preferable to the 35 movable seats all of the same type. By the way of further example, the cabinets designed for holding the room library may not prove suitable and additional experience

---

1/ Plan 6, page 68

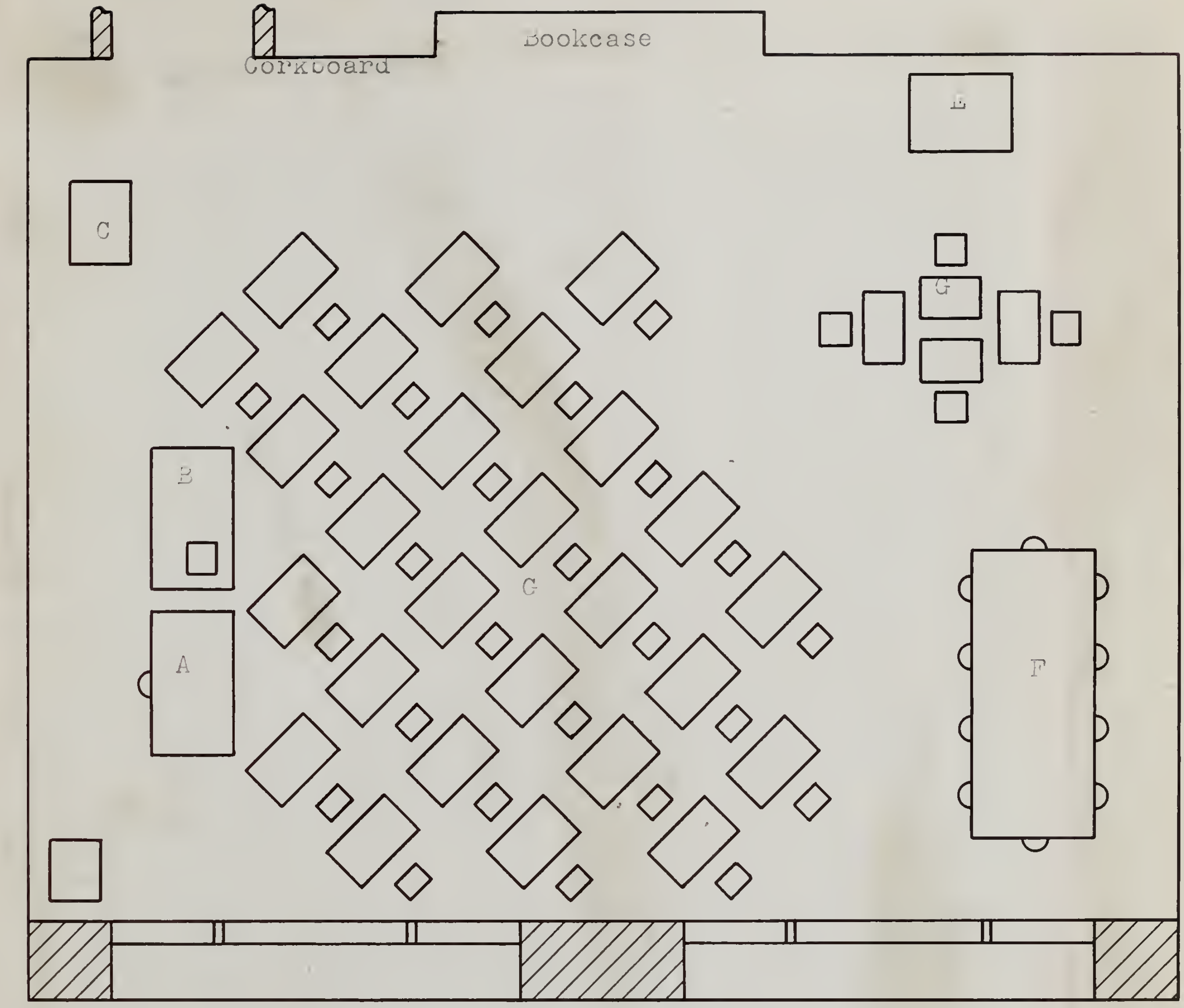
> with them may cause the teachers to rewrite the cabinet specifications. Each piece of new equipment will surely prove to have certain shortcomings and disadvantages that will become evident only through use. Thus far there has been no great rush to convert a large number of standard English classrooms. But the conversion will be made progressively when a thorough testing period has elapsed, and those concerned are quite sure that they know what they want."

Comments. -- The features of the room described above are the results of studies by committees of teachers in a Chicago, Illinois high school. During the planning of the units the need for certain equipment and room facilities became apparent. A tentative room plan was agreed upon.[1] Many pieces of equipment suggested for each area became permanent features of the room and could be used during the teaching of units of other areas. The amount of bulletin board space as indicated on the diagram of the floor plan does not seem to be adequate. Apparently adequate provisions for audio-visual aids were already available as they are not listed as imperative needs in this situation. Various plans of arrangement of seating and room facilities are possible, giving the room the advantage of flexibility.

A room of this type should be adequate for the teaching of English in most high schools. An evaluation of the features of this classroom by the teachers them-

---

[1] Plan 6, page 68


Bookcase
Corkboard
E
C
G
B
G
A
F

Key

A. Teacher's Desk
B. Recording-Playback Phonograph
C. Book Cabinet
D. File
E. Magazine Rack
F. Conference Table
G. Movable Seats

Plan 6. Layout of a Chicago High School English Laboratory a/.

a/ The floor plan on this page has been adapted by the writer.

selves does not show one-hundred per cent approval of the entire room.

Roy O. Billett[1].

> "The classroom must be a real laboratory with furnishings which adapt themselves readily to change. Pupils must be able to work effectively and efficiently, now as individuals, now as small groups, now as a total group composing the entire class section, under the direction and guidance of the teacher. Classroom libraries must change with successive units of instruction. Suitable filing equipment is a necessity. Exhibit cases, bulletin boards, pictures, maps, charts, and other visual aids must be available as needed. Sound-recordings and sound-producing devices are invaluable both as aids to instruction in the oral English of all pupils and as an incentive to artistic oral work on the part of a gifted few. Loud speakers in each classroom should make it possible for any class section to cut in on a regular broadcast when that seems desirable, or for the pupils of one class section to 'broadcast' their work in oral English to the pupils in the other class sections. A little theatre or an effective substitute for each classroom should be available. True, much of the equipment here suggested will not be at once, or even for a long time to come, available in many schools."

Comments. -- Billett, Professor of Education at Boston University, gives his views regarding an English laboratory. A good list of the general features of a classroom and the most necessary equipment needed in the teaching of the reading, writing, and oral phases of English are included.

N. L. Engelhardt and Joseph M. Leps[2]. -- Engelhardt,

---

[1] Op. cit., Billett, p. 212-213.

[2] Op. cit., p. 248-250

Professor of Education at Columbia University, and Leps, a graduate student at the same university, suggest the diagram[1] of an English laboratory which they consider as satisfactory from the viewpoints of adequate equipment, flexibility, coziness, and friendliness. Space is provided for activities which are associated with the teaching of English such as dramatics and conference groups. It is planned for use not only by the students of the school but also by the out-of-school youth and members of the community.

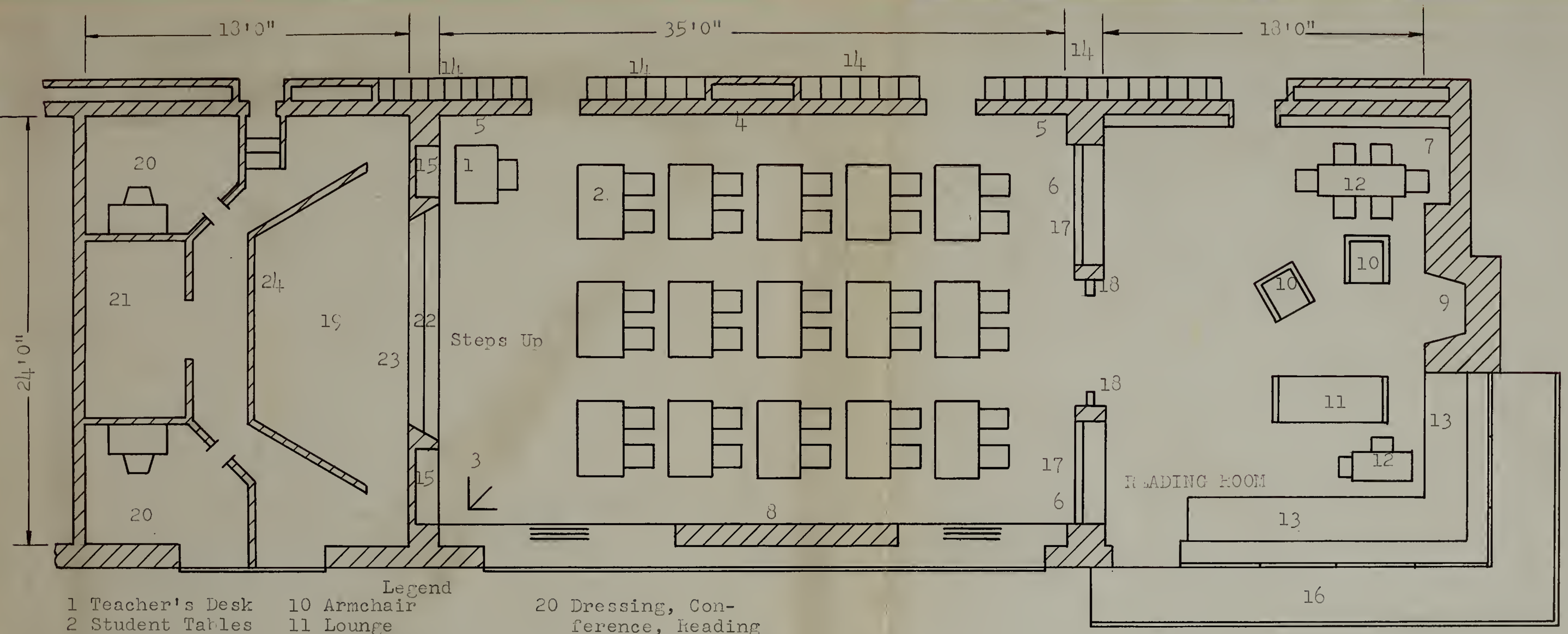
This room is the most elaborate of any of the English classrooms considered. The cost of such a room is high, but it should prove to be a very satisfactory one from an educational standpoint.

Essential Features of a Good English Classroom

Conclusions. -- There are many differences between the rooms described in this chapter. This writer, however, is much more impressed by their similarities. Most of the rooms described in this chapter stress the same characteristics. A great deal of bulletin board space, exhibit cases, a classroom library, comfortable seating, a conference table with chairs, storage space, filing equipment, a stage, sound-producing and sound-

---

[1] Plan 7, page 71


13'0"
35'0"
18'0"
24'0"
14
5
4
1
2
6
17
18
7
12
10
9
11
13
16
20
21
24
19
22
23
15
3
8
Steps Up
READING ROOM

Legend

1 Teacher's Desk
2 Student Tables
3 Sectional Movable blackboard
4 Blackboard
5 Tackboard
6 Cabinet
7 Bookshelves Cabinets Below
8 Open shelves, Flowerbox above
9 Fireplace
10 Armchair
11 Lounge
12 Reading and Conference Table
13 Window Seat
14 Lockers
15 Open Shelves, Statuary Niche
16 Terrace
17 Glass Screen
18 Folding Door
19 Stage
20 Dressing, Conference, Reading or Listening room
21 Storeroom
22 Overhead Speakers for Radio, and talking pictures
23 Motion Picture Screen
24 Cyclorama

Plan 7. English Laboratory a/.

a/ The floor plan on this page has been adapted by the writer.

recording apparatus are features which are most commonly suggested as being important in the improvement of the English classroom. These facilities combined with an attractive homelike atmosphere, adequate provisions for audio-visual aids, and flexibility within the classroom provide the basic features of an English laboratory. The best classroom for one school may not be the best classroom for every school.

The features of English classrooms as recommended by the various writers are summarized here for easy reference. It is not expected that any classroom will include all of the features. Only those features which will aid and add to the educational program of a school should be selected.

Room size. -- The recommended size of a single English classroom will vary greatly according to the number of students which it must accommodate and the type of a program which is to be carried on within the room. To accommodate thirty students Engelhardt and Leps[1] recommend a classroom 24 feet by 35 feet. A stage 24 feet by 15 feet which includes two dressing rooms and a storeroom and a reading room 24 feet by 16 feet are additional parts of the classroom.

---

[1] Op. cit., p. 250

Blackboard. -- Wall (twelve linear feet), sectional movable.

Bulletin Board. -- Cork or burlap (as much as possible).

Bookcase. -- Enough to accommodate classroom library, open or closed shelved.

Cabinets. -- Filing cases, storage, card catalogs, display.

Seat-desk equipment. -- Movable single unit seats, fixed seats, movable desks and chairs, teacher's desk and chair, conference tables and chairs, armchairs, lounge, window seat.

Miscellaneous furniture fixtures. -- Magazine rack, fireplace, stage (fixed or movable), dressing rooms, conference rooms, reading room connected to recitation room by folding doors, flower box.

Audio-visual aids. -- Charts, maps, lectern, opaque projector, motion picture projector, slide projector, slide film projector, projector screen, recording and play-back apparatus, phonograph, recordings, films or slides (for various projectors), radio broadcasting station (real or mock), interroom radio for broadcasting programs to other rooms.

Miscellaneous. -- Tote boxes, library catalog cards, duplicating apparatus and supplies.

Books, magazines, and periodicals. -- The range of titles is so large that no attempt is made by the writer to make a list of even suggested material. The selection of reading material by a teacher for a classroom library should be made based upon the four following criteria: (1) reading levels of the students (2) interest of the students, (3) how functional the reading material is in the lives of the students, (4) the units of instruction.

CHAPTER V

THE SOCIAL-STUDIES CLASSROOM

The Changing Design of the Social-Studies Classroom

The social-studies classroom of the traditional high school. -- Any room, as long as it contained a few maps and a globe, was in the past considered as an adequate place for the instruction of social studies. Some teachers and administrators felt that the pupils did not need convenient writing space because most of the class work was oral recitation, discussion, or lecturing by the teachers. Recently teachers of social studies have felt that some type of movable seating to allow for a more informal seating plan was an aid to instruction in this field. If history is still taught in chronological order by the lecture or question-answer technique, it may well be that these classrooms are quite adequate.

The modern social-studies program. -- The reorganization of the social-studies curriculum has affected the needs of a classroom. Economics, civics, history, and geography have begun to disappear from the curriculum as individual courses. The content of these courses has become fused into units or topics of a more generalized

[illegible]
[illegible]

[illegible]

course in social studies which have been distributed at varying levels of secondary education. The method of instruction has become the unit method. The problem-solving technique, to function properly, necessitates a type of classroom best described as the social-studies laboratory.

Recommendations for Social-Studies Classrooms

Lester K. Ade [1].

> "Before and during the work of the unit the teacher and the librarian, if any, should plan the nature and use of visual materials. Films, slides, diagrams, graphs, and pictures may be used extensively throughout the progress of the work. Early planning of this phase of the program by all the teachers working cooperatively will make it possible to a large degree to use these materials as they are needed. The pupils should also be encouraged to bring to class any pictorial materials they have collected or found during their search for materials. Space should be provided for storing flat materials such as pictures, clippings, posters, charts, and other similar aids. Some schools have discovered that the most efficient plan is to locate a filing case at some central location, preferably the library, where all materials can be made available to all teachers.
>
> Every teacher should have in his classroom a filing cabinet or drawer for keeping records of the pupils' reading and other pertinent information. The record forms, if made uniform for all teachers, can be passed from one teacher to another.
>
> A large bulletin board, an important feature

---

[1] Lester K. Ade, Suggestions for Developing a Social Studies Program in the Secondary School, Bulletin 411, Department of Public Instruction, Harrisburg, Pennsylvania, 1939, p. 16-17.

> of every classroom, should be located where it can be seen by all pupils in the room. Its effectiveness depends upon its use. If it is used for the display of materials such as clippings, pictures, book lists, charts, diagrams, and posters which are kept fresh and appropriate, it becomes a vital part of the classroom environment... .
>
> A social-studies program cannot be adequately and efficiently conducted without facilities for housing and filing reading materials and for reading purposes. The reading program in the social studies also necessitates the reservation of space in the classroom for a reading table, confortable chairs, and book shelves. Under these conditions the teacher is enabled to guide and encourage the pupils in the development of desirable reading habits and to direct the growth of skills, attitudes, and thought processes fundamental to a thorough and scholarly consideration of social problems."

Comments. -- Ade stresses the need for a room that will adequately provide for storage and filing facilities for reading materials and visual aids. Plenty of display facilities should also be provided. A reading table and comfortable chairs are also needed to make this room well-equipped. The features described are intended to make the room suitable for the unit method of teaching. There must be cooperation between teachers and between teachers and librarian if the program is to be carried on efficiently.

Bining and Bining[1].

"The Social-Studies Laboratory Equipment. -- A

---

[1] Arthur C. Bining and David C. Bining, Teaching the Social Studies in Secondary Schools, McGraw-Hill Book Company, Incorporated, New York, 1941, p. 155-156.

discussion of the laboratory equipment necessary in a social-studies laboratory presents many problems. In the natural sciences, there is more or less agreement as to what should comprise the laboratory. In the social studies, there is no such agreement. A wide difference of opinion prevails over what may be regarded as essential equipment. From a study of the literature on the subject, varying emphasis is placed on floor space (generally about one and one-half times as much per pupil as in the ordinary classroom); seating arrangement in which tables and chairs instead of desks and benches are advocated; bulletin board; blackboards; filing cabinets; bookcases filled with different kinds of textbooks, reference books, and encyclopedias; dictionaries; atlases; maps; pictures; and charts and graphs as well as the usual work materials including ink, pens and pencils. One writer[1] makes the following recommendations for the social-studies classroom or laboratory:

'1. A room larger than the conventional classroom and equipped with tables -- two pupils to each -- and chairs.

2. A bulletin board extending the full length of the rear of the room.

3. A blackboard across the front and possibly along one side of the room.

4. Shelving below the blackboard in the front part of the room, with sufficient cupboard space and a glass display case for objects of value.

5. A filing cabinet.

6. Equipment for projectors for the use of slide and motion pictures.

7. Suitable maps.'

---

[1] J. B. Wiechman, _A Survey of Equipment and Materials Used in the Social Studies Department of the Los Angeles Junior High School_, (unpublished Master's thesis, University of Southern California, 1930) abstract in _Historical Outlook_, 22:174. (April 1931).

> The most exhaustive study concerning equipment for the social-studies laboratory is that made by Dr. J. W. Baldwin.[1] His report is based on a careful investigation of the equipment necessary for teaching effectively the social studies in grades four to twelve. He secured the material for his study from social-studies teachers or from those connected with the social-studies departments of various schools, from analyses of courses of study and books on method in the field, and from the inspection of equipment used in the teaching of the social studies in many high schools. One of the most significant conclusions in his report is the emphasis placed on seating arrangement of the laboratory -- tables and chairs or the single-unit desk and chair being advocated. This item of seating arrangement ranks first in importance in his study for all the subjects of social studies. The next item of importance, taking the social studies as a whole, is the bulletin board. The third item in order of importance is the blackboard, although the demand, according to the study, is not for an excessively large amount of blackboard space. There is much variation of opinion concerning all other items of equipment necessary for a laboratory. A table dictionary and a large atlas rank high for geography, but low for civics in the junion-high school; in the senior-high school, a high rating is given them for all subjects. An almanac is considered important in all subjects. Naturally books and book cases are emphasized, and supplementary textbooks are given a prominent position. Much difference of opinion, however, is shown as to the types of books and kinds of maps necessary in the social-studies laboratory."

Comments. -- Bining and Bining give not only their own impression of a good social-studies laboratory but also the recommendations of Wiechman and Baldwin. Comfortable seating, adequate room size, bulletin board, black-

---

1/ J. W. Baldwin, The Social Studies Laboratory, Contributions to Education, No. 371, Teachers College Columbia University, Columbia University Press, New York, 1929, 89 p.

board, storage and filing space, adequate provision for visual aids, a classroom library, and suitable maps make up the basic requirements of a room in which the problem technique of teaching is employed.

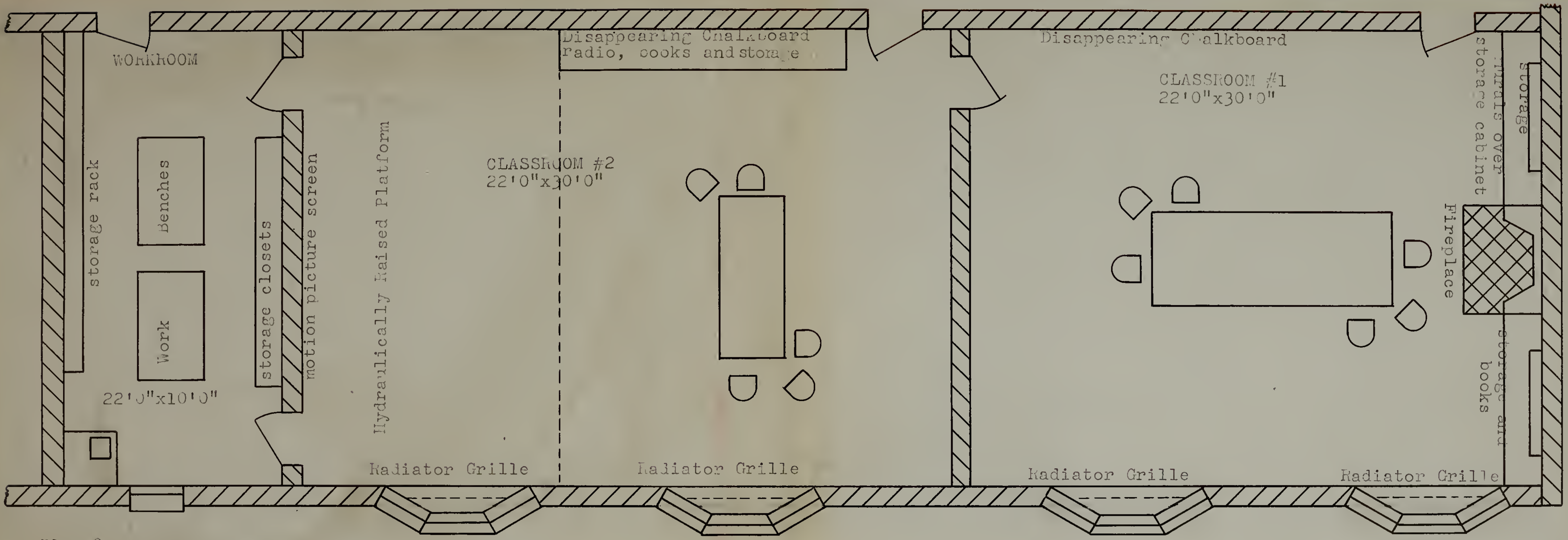
H. Z. Wooden, A. B. Wrigley, and W. L. Lowe [1]. -- The next diagram[2] illustrates the plan of a group of social-studies classrooms with an emphasis on colonial design. It was proposed by a committee of school administrators attending Teachers College, Columbia University, for use in schools of the New England area. It is suggested that classroom No. 1 be used for geography and history; No. 2, for civics and economics, and No. 3, for a work room. The authors point out that other room arrangements could be just as satisfactory. Other features are as follows:

Fireplace and murals: These give atmosphere. The murals are removable and cover different subjects of historical or social significance.

Windows: Bay windows break up the side wall, and provide window seats which conceal the radiators. They are equipped with shades for darkening the room and may be appropriately draped.

1/ H. Z. Wooden, A. B. Wrigley and W. L. Lowe, "A Plan for a Social Studies Suite," School Executive, 54:261-262, (May 1935).

2/ Plan 8, page 81.


WORKROOM
storage rack
Benches
Work
storage closets
motion picture screen
22'0"x10'0"
Hydraulically Raised Platform
Disappearing Chalkboard
radio, books and storage
CLASSROOM #2
22'0"x30'0"
Radiator Grille
Radiator Grille
Disappearing Chalkboard
CLASSROOM #1
22'0"x30'0"
Storage
murals over
storage cabinet
Fireplace
storage and
books
Radiator Grille
Radiator Grille

Plan 8. A Social-Studies Room a/

a/ The floor plan on this page has been adapted by the writer.

Floor: It is covered with inlaid linoleum, with a design to represent colonial pine, a state, or a historical fact or happening.

Furniture: Table (4 by 12), chairs, bookcases, closets, cupboards, files, and other furniture to conform to the colonial style.

Blackboard: The blackboard may be concealed by the use of drapes on metal arms.

Other features: Built-in radio, all necessary equipment for visual aids, folding partition between rooms No. 1 and No. 2, and a hydraulically controlled platform in room No. 2.

Comments. -- The design of this room puts a great deal of emphasis on the colonial atmosphere of New England. The room may be built, however, to give different impressions. It is possible to use Room No. 1 and Room No. 2 for different classes at the same time. If this is true they are only average size clasrooms and neither classroom contains all of the facilities of the other. If both are used by a single class the area may be larger than necessary for a class of 25-30 pupils, but the room would possess greater flexibility and become a much better place for work and study.

This writer doubts that the cost of the hydraulically controlled platform can be justified in terms of greater

use when compared to a built-in platform. The cozy atmosphere of the classroom should do much to make the students feel at home and should make the room very adaptable for use as a club room.

J. W. Baldwin.[1].

> "The floors in all the rooms shown in this plan are of clear hardwood. The legs of all chairs are equipped with metal gliders so cushioned in rubber pads as to make their movements practically noiseless. The ceilings in all the rooms and the corridor are of soundproof materials. The book carriages, the projection stand, etc., are mounted on rubber-tired wheels and casters. In the laboratory, the tables at which the students work are heavy and the legs have wide areas in contact with the floor so that they will not move easily. The chairs being light and tipped with gliders makes it possible for the pupil to push himself away from the table without disturbing others at their work. Thirty-five pupils can get up from these tables and pass from the laboratory with as little noise as is frequently made by one such pupil in leaving the conventional classroom.
>
> Except for the laboratory, all these rooms are equipped with chairs with broad tablet arms, and bookrack, A single-unit chair-desk or a table and a chair for each pupil would perhaps meet the need better. The laboratory is equipped with tables large enough for four pupils to work at each. Although there are advantages in these heavy tables, smaller seating units would provide more flexibility in seating arrangements. It is also easier with smaller units to seat pupils properly with respect to lighting and for listening activities. There is one medium-sized work

---

[1] J. W. Baldwin, "Classroom and Equipment Requirements for the New Social Studies," American School and University, Eleventh Annual Edition, American School Publishing Corporation, New York, 1939, p. 292-296.

table in each of the classrooms, and a very large work table in the laboratory to supplement other facilities.

Each of the regular classrooms is 22 feet wide and 30 feet long. If tables instead of tablet-arm chairs were used, the floor area should be increased 20 per cent to care for the same number of students. Each of these rooms has 125 square feet of blackboard and 65 square feet of bulletin board. It would be much more satisfactory if the amount of space for these two items was reversed. Even 65 square feet of bulletin board space is unusual for a regular classroom for social studies, but it is not enough. And very little blackboard space is required in this field. Each room has an 18-inch strip of cork-board running the entire length of two sides of the room above the blackboard, and an additional unit 3¼ x 4 feet. One end wall is left for future development. Each room has two sets of maps which remain permanently in the room, in addition to the many which are borrowed, when needed, from the laboratory storage room. All the rooms, including the laboratory, are equipped with units of the public address system, which carries announcements, radio programs, and school or departmental programs. Some of the culminating activities connected with units of work often take the form of reports through the facilities of the public address system. Each of the regular classrooms is furnished with a teacher's desk and chair and a cabinet for classroom library and supplies, the cabinet being built-in flush with the wall. Some of the rooms have additional shelves and other equipment as requested by different teachers for special subject needs. The corridor has built-in lockers except for spaces where classroom cabinets are utilizing the wall cavity from the inside. Semi-indirect artificial lighting is provided.

The Social-Studies Laboratory

The most distinctive feature of this physical set-up for the social studies in this school is the workroom or social-studies laboratory, which has already been described to some extent in connection with the description of other classrooms. Other features of this room will be described in

order to emphasize some of the innovations in equipment requirements in the modern approach to the teaching of these subjects.

The floor area of a social-studies laboratory should be at least 50 per cent greater than that of a regular classroom. We were able to hold ours down to that size because of the unusually large amount of space saved by having cabinets and shelves built-in flush with the wall, and by adding a large storage room equipped with shelves and hooks for storage of maps, charts, finished projects, exhibits, supplies, and other materials. This storage room opens into the laboratory rather than into the corridor, so that it cannot be diverted to other uses. The north end wall is occupied by the door to this storage room, a loud-speaker connected with the public address system, a steel filing cabinet (dimensions 52 x 27 x 15 inches), and a bulletin board which is 12 feet long and 4 feet wide. Near this wall on the east wall there is a sink for washing some of the materials and the pupils' hands after completing stages in construction projects, modeling, coloring, etc. Between this sink and the nearest window, space is provided for a museum case which is to be added this year. The remaining part of the east wall is nearly all occupied by windows, under which the radiators are installed. There is a little space left near the other end of the room which can be used for the combination magazine rack and dictionary stand.

The south end wall has a large built-in stationary motion picture screen which is exposed only when it is to be used for projection... . Two sections of blackboard and bulletin board slide back toward either side to expose the screen when needed. At other times this end of the room is occupied by a blackboard over which there are four sections of cork bulletin board 3 feet wide and extending, when combined, the full length of the wall. We should have built a stage at this end of the room.

The west, or corridor, side of the laboratory has a door near each end leading into the corridor, making it possible to bring one group into the room while another is leaving, without creating

traffic jams. Near the south end of this wall, as is shown in the accompanying picture, there is a built-in cabinet for the use of the teacher who has charge of the laboratory. It contains about 16 cubic feet of storage space and has two compartments, each equipped with doors which can be locked. Passing beyond the door adjacent to this cabinet, the next feature is a section of bulletin board about 3½ feet square and a section of blackboard 10½ feet long. Above these two panels there is an additional strip of cork-board 18 inches wide. On the molding above this bulletin board, as well as on that above the blackboard on the south wall, there is a metal map rail equipped with adjustable hooks which can be spaced to match the eyelets in any kinds of maps and charts. Several single maps and a few sets of maps and charts are usually mounted on the map rail. Above this section of wall covering there is an electric clock which is a unit of the system for special rooms in the building. The transoms on the walls are opaque.

Between the second door and the north wall there is a battery of several types of built-in cabinets, shelves, pigeonholes, and cupboards... . This group of filing and storage facilities is 14½ feet in length and 6 ½ feet high, and the inset into the wall is 13 inches. One group of open, adjustable shelves is provided for books. One large cabinet, with doors which can be locked, is used to store the projection equipment. Several wide, adjustable shelves are used for back numbers of magazines and for certain types of unfinished projects. Other shelves hold models and construction projects. Near the floor there are four large cupboards which can be locked when necessary. These are for storage of museum materials and other bulky materials as the need arises. A tier of drawers provides for several thousand slides and index cards. An enormous amount of space is saved in the room by having so many built-in features. This is only one of the many advantages of planning the entire set-up before the erection of the building.

Although there is a bulletin board area of about 120 square feet in this room and a blackboard area of about 90 square feet, we should be glad to sacrifice more than half of our blackboard space for additional bulletin-board space.

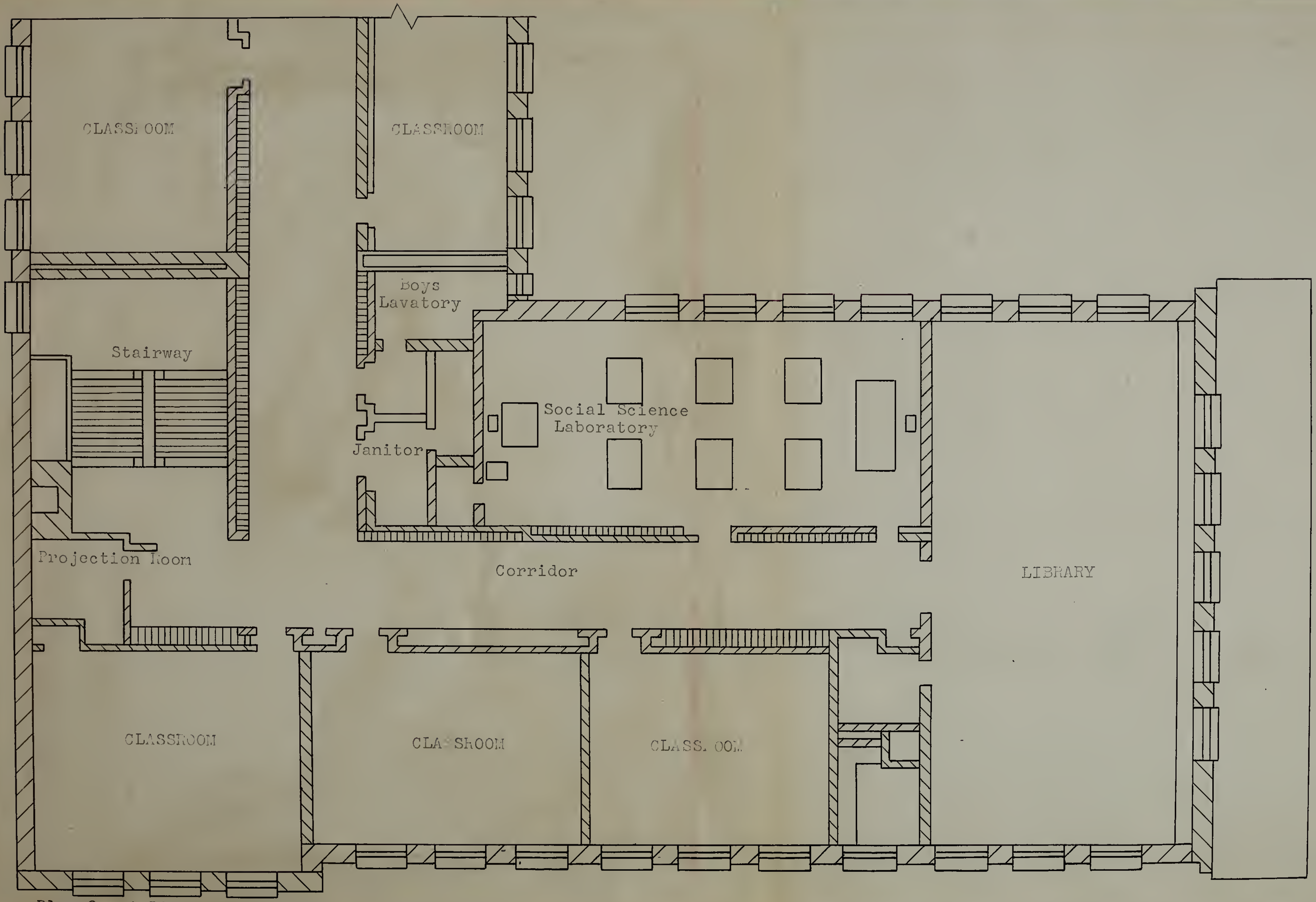
> Display space is much more in demand in such a room than is space for blackboards.
>
> In addition to the translucent shades, the windows are equipped with opaque shades to be used at projection periods. Electric fans are provided for use when the opaque shades impede the ventilation of the room. Base plugs at each end of the room and two floor electric outlets make it possible to obviate long extension cords, which would interfere with movements about the room during projection activities... •
>
> There are many series of maps and charts for use in the laboratory and in other classrooms. There are some globes on tripods which should have been suspended from the ceiling. A number of small articles, such as waste baskets, pencil sharpeners, thermometer, coloring and drawing materials, scissors, rulers, paste, etc., complete the provisions for the type of activities which are carried on in the social-studies department of our University High School. Such provisions are imperative if the social studies are to be taught effectively."

Comments. -- J. W. Baldwin, whose doctorate thesis is referred to by Bining and Bining[1], designed in cooperation with an architect a suite for social studies at the University Junior High School, University of Texas, a school of 1000 to 1200 pupils. In larger schools an additional workroom would be necessary. In smaller schools less classrooms would be required. The library appearing in the floor plan[2] is the school library. The English suite is on the same floor. This

---

[1] Op. cit., p. 156.

[2] Plan 9, page 88


CLASSROOM
CLASSROOM
Boys Lavatory
Stairway
Janitor
Social Science Laboratory
Projection Room
Corridor
LIBRARY
CLASSROOM
CLASSROOM
CLASSROOM

Plan 9. A Library and a Social-Studies Suite a/.

---

a/ The floor plan on this page has been adapted by the writer.

makes it possible for the pupils of both English and history to go to the library as the need arises. It also makes it possible for teachers to integrate instruction in these subjects. The small rooms off the library provide conference rooms and an office for teachers of both English and social studies.

The classrooms and laboratory described here are designed to meet the needs of the modern techniques of instruction in social studies. The floors in the suite are of hardwood. Rubber-cushioned-metal glides on chairs and extra heavy tables have been used for sound-reducing. Although Baldwin indicates that these features have proven satisfactory, this writer believes that the furniture features combined with battleship linoleum, asphalt, or rubber tiled floors would serve to reduce even more the noise created by pupils moving about the various rooms.

Dorothy Gray and Alice Miel[1].

> "The wide variety of activities that will be carried on in the social-studies laboratory demands not only space and a flexible arrangement of furniture but also an area planned especially for work with graphic and plastic materials. One desirable arrangement is a large alcove with floor raised somewhat higher than the main unit. This

---

[1] Dorothy Gray and Alice Miel, "A Laboratory for the Social Studies," School Executive 65: 44-45 (July 1946).

alcove can serve variously as a work area, as a stage for dramatizations, as a platform for participants in panel discussions, etc. In one corner might be found space for one or two typewriters.

The work alcove should be equipped with work tables with composition tops to permit comfortable use of craft materials. Nests of stools would be useful. A sink recessed in an inconspicuous yet accessible spot in the wall would be a necessity in this alcove, where work in a variety of media will be carried on. A gas jet to facilitate simple experimentation with science equipment would be another desirable feature in this work space.

Storage Wall Partitions

To secure a degree of privacy for members of the group who are doing different kinds of work, 'storage walls' may be used in the larger room. These walls are movable units made approximately shoulder height with shelves that can be used for books and pamphlets and with storage space for other supplies. These movable walls afford the opportunity for student planning of various room arrangements. For example, two such walls may be placed at right angles to partition off a listening center for radio and recordings. If the center section is covered with porous material and the shelves are adjustable, these storage walls can become exhibit spots.

Efficient Use of Wall Space

Even with additional shelf space furnished by storage walls careful planning must be made for the use of all wall space. The walls around the work area could contain recessed cupboards for storing the materials most likely to be used in that section of the laboratory. One cupboard could be especially designed for storing housekeeping equipment. Cupboards could be equipped with sliding panels covered with cork or other porous material.

Wall space in the main unit should provide additional cupboards, an exhibit case with sliding glass panels which could be locked, racks for current magazines and papers, some blackboard

space, and as much cork bulletin board space as possible.

Equipment and Supplies

Provision for the use of audio-visual equipment would include numerous electrical outlets, facilities for darkening the room, adequate ventilation of the room while the room is darkened, sound-proofing, and white wall space for projecting pictures. To eliminate confusion in the main unit, a white wall panel may be provided in the work alcove for the use of small groups who want to pre-view a film or slides.

Filing cabinets can be arranged as a unit and can be at the same time decorative and functional. There should be three kinds of filing space -- for the teacher's materials, for materials used by the whole class, and for the work folders of each student. The teacher's work space should be planned in relation to the filing facilities.

To make the home base complete it would be desirable to have locker space and two lavatories housed in a small auxiliary room adjoining the main unit and at the end opposite the work alcove. In this room the teacher's closet might be located. It should be possible to enter this locker space from the corridor as well as from the laboratory. The advantage of this arrangement for reducing traffic in a school are obvious.

Will Help Teachers Do Better Job

Each of the features recommended is designed to facilitate a sound educational program for the varied youngsters in America's schools. Suggestions are based on the premise that a higher quality of learning is likely to take place in a rich environment rather than in a deprived one. A laboratory such as the one proposed would enable the teacher who wants to do a good job to do a better one."

Comments. -- Dorothy Gray, Instructor, Department of Education, Queens College, New York City, and Alice Miel, Assistant Professor of Education, Teachers College,

Columbia University, suggest a plan[1] for a social-studies laboratory which is called the home center of the school. In it pupils are expected to spend from one half to one third of the total school day. It is proposed as a room where all children can acquire the social learnings judged important for a democratic society. Provision is made for 20 to 30 students to work either as a total group, as several smaller groups, or as individuals.

The cost of such a laboratory would naturally be greater than that of a traditional classroom. A modern technique of teaching would be required to take full advantage of the opportunities which this room provides for meeting the individual needs of the pupils.

Engelhardt and Leps.[2] -- The legend of the accompanying diagram[3] gives the features of a social-studies as recommended by Engelhardt and Leps. It is designed to provide for conferences, dramatization and project making, as well as recitation, discussion, and lectures.

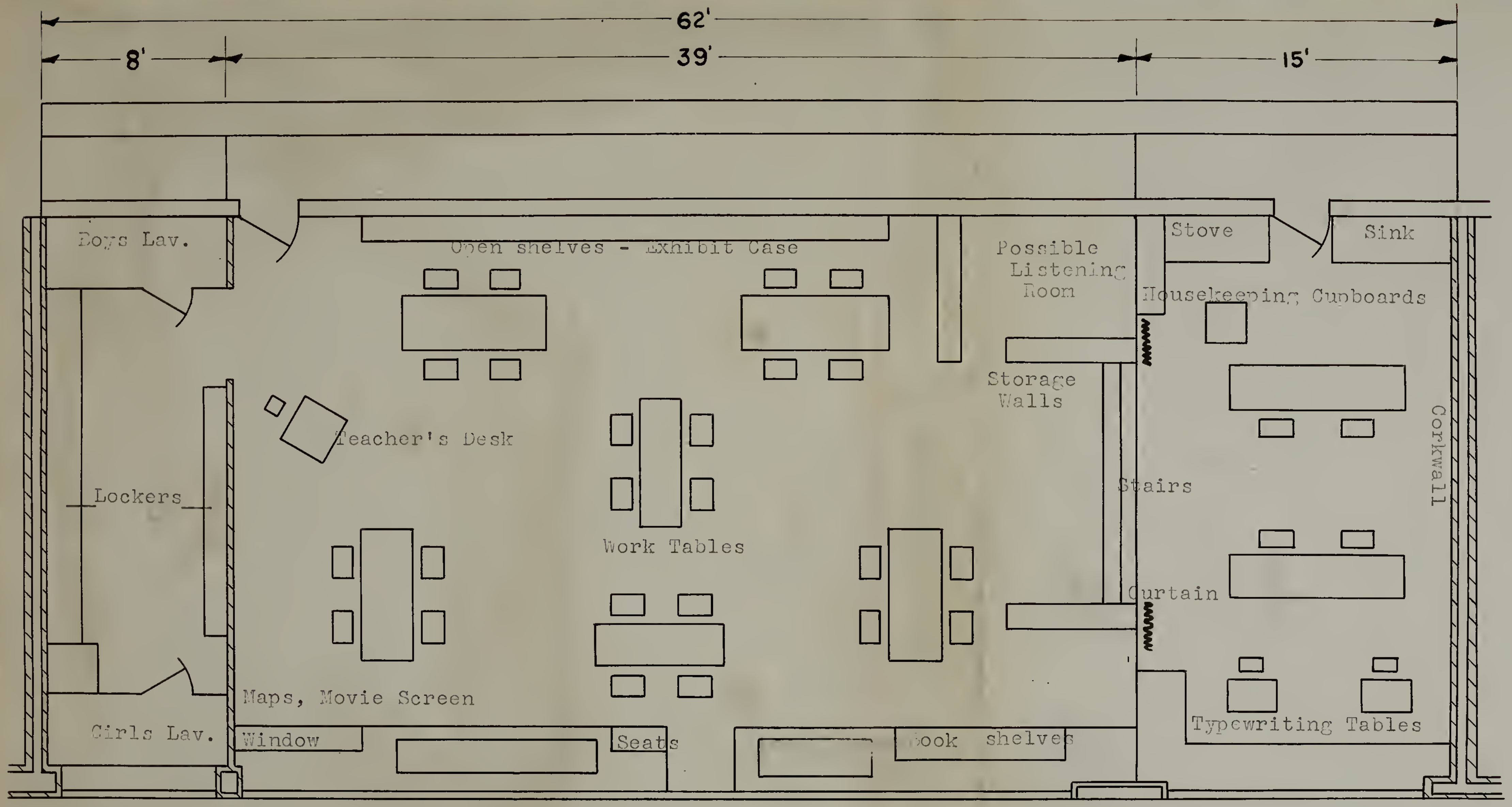
Comments. -- A laboratory of this type should prove adequate for the instruction of the social studies. The modern methods of teaching should function with upmost efficiency in it if they are placed in the hands of

---

[1] Plan 10, page 93.

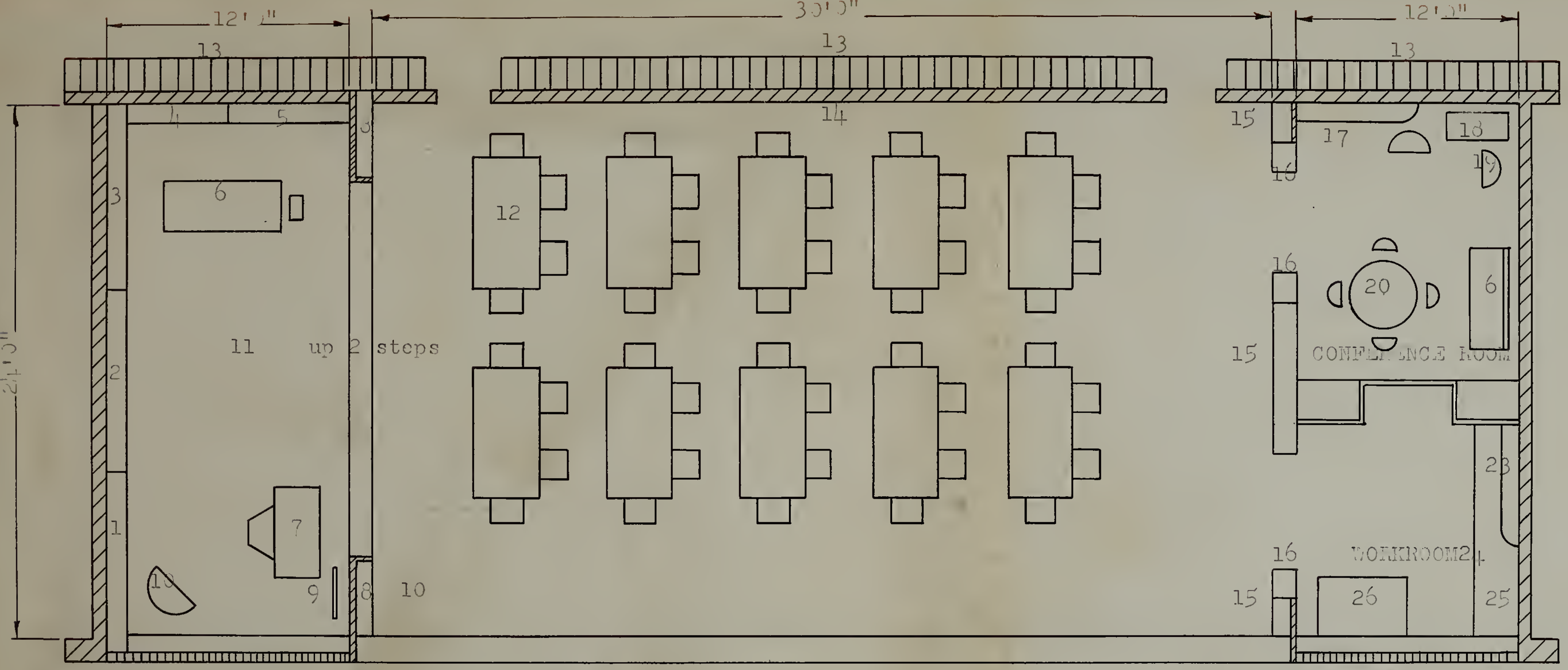
[2] Op. cit., p. 251.

[3] Plan 11, page 94.


62'
8'
39'
15'
Boys Lav.
Open shelves - Exhibit Case
Possible Listening Room
Stove
Sink
Housekeeping Cupboards
Storage Walls
Teacher's Desk
Lockers
Work Tables
Stairs
Corkwall
Curtain
Maps, Movie Screen
Girls Lav.
Window
Seats
Book shelves
Typewriting Tables

Plan 10. A Social-Studies Laboratory. a/

a/ The floor plan on this page has been adapted by the writer.


12'0"
30'0"
12'0"
13
13
13
14
24'0"
4
5
8
3
6
2
11
up 2 steps
1
7
19
9
8
10
12
15
17
18
16
19
16
20
6
15
CONFERENCE ROOM
23
16
WORKROOM
24
15
26
25

1 Storage
2 Local History Museum Case
3 Bookcase
4 Magazine Rack
5 Newspaper Rack
6 Exhibit Table
7 Teacher's Desk
8 Display Cases
9 Movable Blackboard
10 Multiple Display Board
11 Raised Platform
12 Student Tables
13 Lockers
14 Blackboard and Display Board
15 Storage
16 Folding Door
16 Bookcase
18 Table
19 Easy Chair
20 Conference Table
21 Map and Chart Storage
22 Tool Storage
23 Open Shelves
24 Work Bench
25 Work Basin and Sink
26 Work Table

Plan 11. Social-Science Laboratory a/.

a/ The floor plan on this page has been adapted by the writer.

competent teachers.

Annotated bibliography. -- Other references regarding the social-studies classroom, which may have influenced the writer's conclusions but which were not selected by the writer for enlarged presentation in this paper, appear below. The notes are given to aid a reader interested in further study of the social-studies classroom.

Gilchrest, Robert L., and Norman Woelful, "Equipment, Supplies, and Material for the Secondary School," School Executive, 63:40-42, (July 1944). This article lists supplies and provisions needed for effective teaching in social education.

Martin, N. F., "Equipping a High School Geography Room," American School Board Journal, 98: 41-42, (June 1939). A complete list of equipment is given for instruction in geography.

Orth, Albert A., "Planning the Social Studies Classroom," American School Board Journal, 92: 30-32, (January 1936). The suggestions in this study are the results of information obtained from school systems of typical United States cities and information supplied by William B. Ittner, Architect, St. Louis, Missouri.

Stegmeir, Clarence C., "Pictures Teach History," Social Studies, 31: 298-300, (November 1940). A shoproom at Township High School, Harvey, Illinois, was temporarily converted into a history room. The use of pictures in the transformation of the room is described.

Wittkop, N. L., "Specialized Geography Room," Clearing House, 18: 85, (October 1945). This room is designed for use by seventy or eighty pupils. One feature is a table in the center of the room for maps so that the north side of the map may point north. Other features are also given.

The Essential Features of a Good Social-Studies Classroom

Conclusions. -- The requirements of a good social-studies classroom will vary considerably from one high school to another. In a large high school, a suite of rooms with one of the rooms being used and equipped as a laboratory with each classroom having a single work table, may be most satisfactory. For the smaller high school having only one or two social-studies classrooms, it may be that both should be equipped as laboratories or a suite should be built in such a way that the work room may be between two classrooms and can be used by the students of either room at the same time.

An important feature of any social-studies classroom is the provision made for maps. One writer[1] suggests the use of a table so that north on the map is north on the compass. There are also many types of maps which are hung either on the wall or on a tripod stand. They are rolled on either individual or multiple rolls. Each map in a set of these groups of maps must be made by the same manufacturer in order to fit correctly. There is currently on the market a universal map rail to which may be fitted the individual map roll of any manufacturer. Teachers considering the use of this map rail must judge

---

[1] N. L. Wittkop, "Specialized Geography Room," Clearing House, 18: 85, (October 1943).

it according to its ease of use, its purported flexibility, its cost, and how it aids the teaching-learning process.

A brief evaluation of the type of map facilities shows that although a map table allows for better orientation of some maps as to north, east, south, and west, it has the obvious disadvantages that it occupies a great deal of space and that it is possible for only a few to look at the map at one time. Some teachers feel that the use of the tripod type of map stand is almost as bad as having no maps at all. This is because usually only one map can be displayed at a time, because the tripod occupies a great deal of space, and because it is awkward to use. Although the use of the map rail previously mentioned appears to have the advantages of adaptability and flexibility, it, like any commercially manufactured product , must have its value proved in use. It is likely that no one provision for maps will best serve all schools or even one school. Each school must adopt those provisions which will best meet the needs of its students.

Below appears a list of the major features of a social-studies classroom and a list of important equipment needed for use in such a classroom. The majority of the list of equipment is that suggested by Baldwin[1] as the

---

[1] Op. cit., Baldwin, Columbia University Press, p. 51-54 and 66-68.

minimum required for a social-studies classroom. It should be understood that no social-studies room will contain all of the features mentioned below. Some teacher may consider as essential a piece of unmentioned equipment. Each teacher must choose and select that which will best serve the needs of his pupils.

Size of rooms. -- Regular classroom (30 by 22 feet, approximately); classrooms using tables and chairs instead of desks, 20 per cent more; workroom laboratory, 40 to 50 per cent more; accomodates 25 to 30 pupils.[1]

Blackboard. -- (12 linear feet for each room).

Bookcase. -- Either built-in or open shelves (one for each room).

Cabinets. -- Card catalog, charts and maps, pictures and clippings, unfinished work, lantern slides.

Seat and desk equipment. -- Tables and chairs or single-unit chair and desk, teacher's desk and chair, armchairs.

Bulletin board. -- Cork or burlap (as much as possible for every room), multiplex-displayer, glass enclosed with lock.

Miscellaneous furniture and room fixtures. -- Cupboard for tools and supplies, map case for roller maps, map rail,

---

[1] Op. cit., Baldwin, American School and University, p. 294.

tripod map stand, display table for maps, table for dictionary and atlas, fireplace, folding partitions between rooms, platform stage, work benches equipped with water, sinks, storage walls, hydraulically controlled platform, motion picture screen or white wall, typewriters, nests of stools.

Encyclopedias. -- General, historical, childrens'.

Newspapers. -- Local, national.

Periodicals. -- *Current History*, *Literary Digest*, *National Geographic*, *Review of Reviews*, *Current Events*, yearbooks (*American and International* or *Statesman's*).

Collateral reading. -- Biographies, government and state bulletins, historical documents, historical fiction, sourcebooks, supplementary texts, reports of Foreign Policy Association, geographical readers, historical plays.

Globes. -- Political (placed on tripod stand or suspended from ceiling).

Historical wall maps. -- American series, economic series, European series.

Political-physical wall maps. -- Africa, Asia, Europe, hemisphere, North America, South America, state, United States, World, city.

Slated-outline maps. -- Europe, United States, World, North America, South America.

Miscellaneous maps. -- Atlases (historical and geographical), desk-outline maps, population, rainfall, relief, vegetation, temperature, air route, topographical.

Pictures and visual aids. -- Topical collections of small pictures and prints, large mounted pictures, slides, illustrated booklets, motion-picture films, steamship and railway folders, wall pictures.

Multigraphing apparatus. -- Rexograph, ditto, mimeograph.

Projection lanterns. -- Stereoptican with opaque projector attachment, motion-picture machine (mounted on rubber tired carriage), strip-film projector, slide projector.

Miscellaneous apparatus and supplies. -- Charts and graph paper, map-making equipment, paste, pencil sharpeners, scissors, cardboard for mounting, cardboard for construction, drawing materials, plaster of Paris, water paints, clay, radio, phonograph, radio-phonograph, housekeeping equipment, ballots, paper money.

Economic and industrial exhibits. -- Minerals and rocks; specimens, economic and industrial; textiles, raw and manufactured.

Science equipment. -- Weather-map service, barometer, hygrometer, anemometer, barometer, gas jet, electrical outlets.

CHAPTER VI

OTHER CONSIDERATIONS

Common Features

Problems common to most classrooms. -- The following problems common to all classrooms have not been considered in detail: seating, size of room, floor covering, wall and ceiling decorations, heating and ventilation, and lighting. In the sections which follow each of these is considered in turn.

Seating. -- It is almost unanimously agreed that some type of flexible seating should be used in all classrooms, but it has yet to be agreed whether the single-unit desk and chair, the individual desk and chair, or the conference table and chairs are the most satisfactory. Furniture of this type should be as comfortable as possible and should encourage, not hinder, good posture. Some educators feel that lounge and armchairs are conducive to learning. Although it is to be expected that some reading alcoves may be supplied with these, it is doubtful if their use will be any more extensive because of the excessive cost. It is well to note that there is no single best type of seating. It is very possible that

as the subject matter, the number of pupils in the class, the teacher, the pupils, the method of instruction, the classroom space, and the classroom activities change, the type of seating best suited to the need of the group also changes. Regardless of the type of seating equipment used, it must provide flexibility. If it fails to do this, progress cannot take place without added expense.

Size of room. -- A good summary regarding room size appears in the Architectural Record[1]. This is a summary of research made by the editors of this magazine from material made available to them by Teachers College, Columbia University. The classrooms in this summary are divided into these types as suggested by some architects (N. L. Engelhardt and others).

The first of these types is the "recitation-discussion" room. This room provides area for seating, storage, and a reading alcove. It is more adequate than many of our present classrooms, but it does not provide space for all of the activities that should take place

---

[1] Architectural Record, "Building Types -- High School Classrooms," 86:92-94 (August 1939).

Also, Ronald Allwork, "Activity Classroom Planning," Architectural Record, 89:101-102 (June 1941). Information collected by Ronald Allwork. Sources include: American School Board Journal; and the published work of N. L. Engelhardt, Jr., and T. C. Holy, Professor of Education, Ohio State University.

in a classroom where the modern techniques of teaching are used. The reading alcove will provide a place where supplementary reading materials may be kept. A table and chairs may be a part of this alcove. Some type of flexible seating should be provided in the classroom to make full provision for discussion grouping.

Table 1

Area Requirements for Recitation Discussion Program[a]

Spaces	Acceptable Minimum	Average	Usual Maximum
(1)	(2)	(3)	(4)
Classroom			
Total area (sq.ft.). . .	660	704	770
Pupils (per room) . . .	20-25	30	40
Area (per pupil)[b]. . . .	22	234	25.6
Auxiliary spaces			
Storage (cu. ft.). . . .	125	170	250
Reading alcove (sq.ft.).	64	100	176
Book shelves (lin.ft.) .	30	50	60

---

[a] Adapted from the Architectural Record 86:94 (August 1939).

[b] Legal minimum area in many states is fifteen to sixteen square feet per pupil.

The second of these types is the "discussion-activity" room. This room provides area for seating, storage, a workroom, a stage, and a reading alcove. A room of this type represents the minimum requirements which can be expected of a room which will adequately meet a majority of the needs of the modern techniques of teaching.

Table 2

Area Requirements for Discussion-Activity Program[a]

Spaces	Acceptable Minimum	Average	Usual Maximum
(1)	(2)	(3)	(4)
Classroom			
Total area (sq. ft.). . .	704	828	1200
Pupils (per room). . . .	20-25	30	35-40
Area (per pupil)[b] . . .	23.4	27.6	40
Auxiliary spaces			
Workroom (sq. ft.). . . .	176	230	360
Reading alcove (sq.ft.) .	64	100	176
Stage (sq. ft.)[c].	140	252	352
Teachers' office(sq.ft.).	100	100	150
Book shelves(lin.ft.) . .	40	55	70
Storage (cu.ft.).	200	320	400

---

[a] Adapted from the Architectural Record 86:94 (August 1939)

[b] Legal minimum area in many states is fifteen to sixteen square feet per pupil.

[c] Desirable width for classrooms and workrooms based on lighting and similar factors, ranges from twenty-two to twenty-four feet. Length is variable. Most practical stage depth is fourteen to eighteen feet, width variable.

The third of these types is the "experience program" room. This room provides area for seating, stage, exhibition, storage, and separate though adjoining work centers with their own storage space. The greater per pupil area and separate work center which are features provide greater flexibility than the other types of classrooms.

Table 3

Area Requirements for Experience Program[a]

Spaces (1)	Acceptable minimum (2)	Average (3)	Usual Maximum (4)
Discussion			
Pupils (per room)	25	30	35
Total area (sq.ft.)	616	736	864
Seating area(per pupil, sq.ft.)[b]	10	10	10
Auxiliary(in discussion room)			
Stage area(sq.ft.)[c]	140	288	396
Exhibition	As much as available		
Storage (cu.ft.)	80	100	140
Work center[d]			
Pupils(per room)	25	30	35
Total area(sq.ft.)	875	1200	1800
Area per pupil(sq.ft.)	29	40	60
Storage cubicles	25	30	40

---

[a] Adapted from the Architectural Record 86:94 (August 1939).

[b] Legal minimum area in many states is fifteen to sixteen square feet per pupil.

[c] Desirable width for classrooms and workrooms based on lighting and similar factors, ranges from twenty-two to twenty-four feet. Length is variable. Most practical stage depth is fourteen to eighteen feet, width variable.

[d] Practice one width of work center, twenty-five to thirty feet, length variable.

Floor covering. -- In selecting floor covering several factors must be considered. Durability, economy of installation, ease of repair, cleanliness and sanitation, resilience and quietness, safety, and light reflection are important. Battleship linoleum, asphalt tile, and rubber tile floors meet these requirements for use in an ordinary

classroom. Hardwood flooring may be used but tends to be noisy. With wood flooring all movable furniture should be equipped with glides silenced with rubber inserts.

In a science laboratory, the flooring must be acid resistant and easily washed with a hose. Integrally hardened and dustproof concrete or terrazzo is recommended.1/

Wall and ceiling decorations. -- The important factors are cheerful effects, ease of cleaning and high light reflection. The walls may be plastered, surfaced with plywood, or faced with tile. The interior wood finishes should be covered with a light clear varnish. Gloss varnish or dark stain are not recommended. The ceiling may be plastered or covered with acoustic material. In the modern classroom, the use of acoustic material must receive careful consideration. The use of almost any tint is practical with blues, blue-greens, and greens, particularly valuable in reducing eyestrain. For psychological reasons, warm colors are effective on northern exposures and cool shades on southern exposures. Too much emphasis cannot be placed upon the harmonious use of color in the classroom to provide warmth and cheerfulness and to encourage pride and respect for school property. Paints

---

1/ Division for Schoolhouse Construction, State Department of Education, Charleston, West Virginia, Standards for Schoolhouse Construction, Jarrett Publishing Company, Charleston, West Virginia, 1945, p. 52.

on ceilings should have a light reflecting value of at least 75 per cent. Walls should be covered with a non-glossy, flat, or mat-type paint of at least 60 per cent light reflecting value. The wall surfaces below the eye level and working surfaces should have a light reflecting value of approximately 30 per cent.

The above paragraph is adapted from the suggestions made by the Department of Education in West Virginia.[1]

Heading and ventilation. -- A summary of what any good heating and ventilation system must do in order to be satisfactory is given by Don L. Essex, Director of School Building and Ground Division, New York State, Department of Education.[2]

> "It is generally recognized now that for classroom heating and ventilation, equipment should be designed and installed to achieve two purposes:
>
> 1.Provide a proper thermal environment in the school building. That is, the building should be held at an even, satisfactory temperature... . Relative humidity plays a minor role in thermal comfort at customary indoor winter air temperatures... . At outside air below 50 or 55 degrees an air change of 15 CFM is considered adequate for cooling. At higher outside temperatures, the problem can be solved rather simply -- window and corridor doors are opened wide when the room temperature gets too high.
>
> 2.Eliminate odors and toxic substance from the atmosphere.

---

[1] Ibid., p. 29-38.

[2] Don L. Essex, "What's What in Schoolhouse Building Design," School Executive, 66: 60. (December 1946).

> Normal body odors are kept below significant levels by dilution with fresh air at the rate of 10 cubic feet per minute per pupil... .
>
> Three common types of ventilating systems are in common use: (1) Open window system with gravity or forced exhaust, (2) Unit ventilator, (3) Central fan with exposure zoning."

It should be noted that air disinfection and radiant or panel heating are in an experimental stage and may prove satisfactory for classroom use. At the present time, no classroom heating and ventilation system has proved entirely satisfactory. All seem to be too expensive, noisy, or inefficient.

Lighting. -- Although experts do not agree regarding the best method of lighting, they show some agreement regarding the amount and kind of light that should be in each classroom. Essex[1] has again given an excellent summary of the trends in schoolhouse lighting.

> "There seems to be four trends in school plant lighting, two of which conflict with each other... .
>
> 1. The Quality of Light ....A tentative report of the School Lighting Committee of the Illuminating Engineering Society suggests 40 foot candles. Some authorities speak of from 50 to 100 foot candles. Fluorescent lighting has greatly encouraged the higher levels.
>
> 2. Increased attention to the "company foot candles keep." A classroom might have 30 foot candles, yet seeing conditions be worse for the eyes of the children than in another classroom having only 10 foot candles.

---

[1] Ibid., p. 60-61.

> Such matters as brightness, contrast, brightness ratios, glare, and distribution of light, are almost as important as the quantity of light.
>
> 3. Efforts to Get More Daylight into the Classroom.... (1) protruding the classroom away from the corridor and placing windows on two adjacent sides at the traditional levels (2) lowering the roof of the corridor and placing clerestory windows in the inside walls of the classroom above the corridor roof. These windows are in addition to the regularly placed windows in the outside wall of the classroom. This method can be used only in one story structures.
>
> 4. A slight tendency toward depending almost wholly upon artificial lighting as the main light source and using the windows just to see out."

There are other means of creating bilateral and trilateral lighting that Essex has not mentioned in his summary. The use of glass brick to create indirect diffused lighting is being attempted in some schools. Fluorescent light, proclaimed by some, has not proved satisfactory in all schools. In some schools, photoelectric cells have been used to turn artificial lights on and off as the natural light varies. Any type of lighting must be measured according to the ability of the students to study and perform the necessary activities within the classroom with a minimum of eyestrain.

A Model Classroom

Comments. -- An experiment[1] was made in a fifth

---

[1] P. T. Fallon and Willard Allphin, "Model Classroom, One Year Later," School Executive, 66: 33-35. (January 1947).

grade room at the Bowditch School, Salem, Massachusetts. It was conducted by the Sylvania Electric Products, Incorporated, with permission of the school authorities. The problem concerned school-room lighting, but affected most of the classroom equipment. No exact measurement of comparative educational results is available because of the lack of a controlled situation. Certain factors seem to indicate satisfactory results. No pupil in the class of thirty-two was refused promotion although retardation is still recognized as a part of the policy of the school system. The pupils showed a high degree of interest in this work, cooperation with their teacher, and an appreciation of an attempt to improve their physical environment. Although this experiment was carried on at the elementary school level, the writer believes that the results of the experiment can be applied to the secondary school level.

The experiment. -- The essential methods employed in this experiment were:

1. The lighting fixtures used were regular commercial fluorescent units, placed parallel to the front of the room, modified by replacing the clear glass on the side away from the front of the room with a glass of greater density having a ceramic coating on the inside surface. This was done to reduce the glare in the eyes

of the pupils seated near the middle and rear of the room.

2. In order to operate the lights to maintain forty foot candles at desk top, an indicator was installed on a front row desk and the pupils turned the lights on and off as per indicator. This was more economical than the installation of a photo-electric cell.

3. Louvers, fixed in a vertical position at right angles with the glass, were installed in the windows. This was to eliminate skyglare without interfering with the amount of light on the opposite side of the room. Roller shades were used to exclude the direct sunlight when it was at right angles to the windows.

4. The room was painted in two shades, coral and peach. Washable paint which provided acceptable light reflection without glare was used.

5. White glass chalkboards and dark blue chalk were used. This was not entirely satisfactory but was judged to be an improvement over the traditional blackboard.

6. The tackboard was made by pasting cotton crash over Celotex. The color used harmonized with the room.

7. The floor was covered with asphalt tile of light gray with a slightly marbleizing pattern of black and red to provide a light colored floor that would not quickly show shoe marks and dirt.

8. The pupils' seats were a novelty. They were functional desk-chair units made of light colored wood with unique self-adjusting chairs which automatically tilted backward and forward to accommodate pupils of different sizes and to meet the shifts of body position. Left and right-handed adjustments were provided with a tilted, movable desk top.

CHAPTER VII

CONCLUSIONS

Summary

Writer's conclusions. -- Although it has not been the purpose of this paper to establish conclusions or to evaluate the suggestions made by various writers used as references, it is difficult to make a study of this type without forming some opinions. The writer has formed several which seem to be quite definite. It is impossible to carry on a modern educational program if a room is used by an English teacher one period, a mathematics teacher a second period, and a history teacher a third period. Each area of the curriculum should have a room or rooms of its own and if possible, each teacher should be given a room of his own. The writer realizes that in many schools this is not possible because of an inadequate number of large rooms for large classes and for a great variety of other reasons, but it should be the aim of many more administrators and schoolhouse planners to make this possible.

The situation often occurs in which one teacher may give instruction in more than one subject. It is the

writer's suggestion that this teacher be given a room of his own. A teacher may then do with the equipment of the room what he wishes. If the space provisions of the room are adequate, he can do a better job of teaching than he can in several rooms in which all equipment and apparatus seem to be under the control of other teachers.

Differing problems of different schools. -- Every room must contain a great deal of equipment and apparatus related to the subject for which the room is used. Four walls, a teacher's desk, and thirty seats are not sufficient equipment for a classroom in any subject. The work table, working space, a stage, a reading alcove, and a classroom library are important features in most classrooms.

Every school has problems peculiar to itself and these problems must be solved in the best interests of its students. Through careful planning it is possible for nearly every school to improve its educational program through better and more appropriate classroom facilities.

A Checklist

Organization of the checklist. -- The checklist given below is given as a result of the study. It should be valuable to teachers by suggesting ideas for

schoolroom development. In a different form it might serve as a basis for further study in a survey of secondary school classrooms. After several of the items, particularly those of a technical nature, a desirable answer is suggested. This is not intended to be the only correct answer but one which will indicate a reasonable standard. The technical aspects are listed as briefly as possible. These, as well as the apparatus and equipment of the classroom, are considered not so much according to amount or type but according to their appropriateness and adequacy of performance.

Several of the features are listed in detail. A classroom containing only a few of these features may be more functional than a classroom having many of them. For this reason, many sections of the checklist contain a statement weighing the value of the feature.

The checklist

I. Technical aspects

    A. Lighting

        1. Natural lighting

            a. Amount of light at desk level (40 foot-candles desirable)

            b. Absence of glare

            c. Use of glass brick

            d. Window shades

        - e. Louvers at windows to reduce direct lighting.
        - f. Provisions for getting light to corridor side of room by bilateral or clerestory lighting.
        - g. Absence of disturbing shadows
        - h. Ability to see in every part of the room without eyestrain
    - 2. Artificial lighting
        - a. Amount of light at desk level
        - b. Absence of glare
        - c. Absence of disturbing shadows
        - d. Ability to see in every part of the room without eyestrain

- B. Room size
    - 1. Seating area (desirable minimum in square feet, 10 square feet per pupil)
    - 2. Workroom area (230 square feet)
    - 3. Reading alcove (100 square feet)
    - 4. Stage (252 square feet)
    - 5. Adequacy of the size of the room (it must be large enough to serve the needs of the pupils using it.)
- C. Heating and ventilation
    - 1. Temperature maintained at 68 degrees F.
    - 2. Elimination of odors and toxic substances (Rate of change of air should be 10 cubic feet per minute, per pupil.)
    - 3. Apparatus (quiet during operation)
- D. Floor covering
    - 1. Durability

    2. Color (thirty per cent light reflecting value)
    3. Resilience
    4. Quietness
    5. Ease of repair
    6. Cleanliness and sanitation
    7. Safety
  E. Wall covering
    1. Acoustics
    2. Color
      a. Ceiling (light reflecting factor of seventy per cent or greater)
      b. Walls above eye level (light reflecting factor of sixty per cent)
      c. Working spaces (light reflecting factor of thirty per cent)
      d. Harmonious
    3. Absence of glare
II. Functional aspects
  A. Display and exhibition features
    1. Bulletin boards (as much space as possible)
      a. Removable panels
      b. Suitability of material used
      c. Use of "multiplex-displayers"
      d. Glass enclosed with locks
    2. Display cases
    3. Display shelves
    4. Tables

5. Glass enclosed exhibit cases

B. Blackboard

1. English, history, and science classrooms (12 linear feet)

2. Mathematics classrooms

a. Amount (24 linear feet)

b. Spherical blackboards

c. Squared section

d. Section with circle

C. Storage

1. Files

2. Shelves

3. Cupboards

4. Closets

5. First aid cabinets

6. Lockers

7. Bins

8. Convenience of arrangement of storage facilities

D. Classroom library

1. Number of books, magazines, and periodicals

2. Suitability of volumes

a. Reading level

b. Student interest

c. Functional in lives of students

d. Adequacy of units of instruction

3. Display space for books
4. Magazine rack
5. Suitability of library facilities

E. Audio-visual aids

1. Screen
2. Provisions for darkening room
3. Provisions for ventilating darkened room
4. Convenient electric outlets
5. Sound moving picture projector on rubber-tired stand
6. Silent moving picture projector
7. Slide film projector
8. Opaque projector
9. Microfilm projector
10. Radio
11. Phonograph
12. Broadcasting studio (mock or real)
13. Interoom communication system
14. Duplicator and duplicating equipment
15. Pictorial charts and maps
16. Models
17. Globes
18. Calculators
19. Television
20. Recording machine (wire, tape, or record)
21. General suitability of audio-visual equipment

- F. Provisions for pupil conferences
  - 1. Movable seats
  - 2. Tables and chairs
  - 3. Reading or conference alcoves
  - 4. Conference rooms
- G. Stage provisions
  - 1. Dressing rooms
  - 2. Raised platform
  - 3. Stage equipment
  - 4. Suitability of stage and equipment
- H. Apparatus and supplies
  - 1. Adequacy for activities
  - 2. Availability to students

III. Provisions for home-likeness

- A. Window curtains
- B. Venetian blinds
- C. Easy chairs
- D. Fireplace
- E. Reading lamps
- F. Rugs
- G. Flower pots and vases
- H. Window seats
- I. Opportunity for privacy
- J. Drinking fountains
- K. General home atmosphere

BIBLIOGRAPHY

Ade, Lester K., *Suggestions for Developing A Social Studies Program in the Secondary School, Bulletin 411.* Department of Public Instruction, Harrisburg, Pennsylvania, 1939. 32 p.

Allwork, Ronald, "Activity Classroom Planning," *Architectural Record*, 89: 101-102 (June 1941).

Architectural Record, "Building Types -- High School Classrooms," 86:86-118. (August 1939).

Baldwin, J. W., "Classroom and Equipment Requirements for the New Social Studies," *American School and University, Eleventh Annual Edition*, American School Publishing Corporation, New York, 1939, p. 292-296.

Baldwin, J. W., *The Social Studies Laboratory, Contributions to Education*, No. 371, Teachers College, Columbia University, Columbia University Press, New York. 1929, 98 p.

Bedford, Fred L., "Designing the Mathematics Classroom," *American School and University, Eighteenth Annual Edition*, American School Publishing Corporation, New York, 1946, p. 199-202.

Bedford, Fred L., "Planning the Mathematics Classroom," *School Executive*, 55: 290-292 (April 1936).

Billett, Roy O., *Fundamentals of Secondary School Teaching*, Houghton-Mifflin Company, Boston, 1940, 671 p.

Bining, Arthur C., and David C. Bining, *Teaching the Social Studies in the Secondary Schools*, McGraw-Hill Book Company, Inc., New York and London, 1941. 378 p.

Campbell, C. G., "Scientific Laboratory Furniture During the Past 50 Years," *American School Board Journal*, 100: 44-45 (March 1940).

Carroll, L. Grace, "Mathematics Classroom Becomes a Laboratory," *Multi-Sensory Aids in the Teaching of Mathematics, Eighteenth Yearbook*, Bureau of Publications, Teachers College, Columbia, New York,1943,p.16-22.

Clark, Letta M., "Room of Her Own," *English Journal*, 30: 148-149 (February 1941).

Cook, Mary Ruth, "Stimulating Interest in Mathematics by Creating Mathematical Atmosphere," *Mathematics Teacher*, 24: 248-254 (April 1931).

Division for Schoolhouse Construction, State Department of Education, Charleston, West Virginia, *Standards for Schoolhouse Construction*, Jarrett Publishing Company, Charleston, West Virginia, 1945, 84 p.

Dolloff and others, "Facilities for Correlated Work in the Science and Arts," *American School and University, Fifteenth Annual Edition*,American School Publishing Corporation, New York, 1943. p. 193-195.

Eckles, W. G., "The Question of Equipment," *Nation's Schools*, 26: 40-41 (July 1940).

Engelhardt, N. L., and Joseph M. Leps, "Designing Secondary School Classrooms," *American School and University, Fourteenth Annual Edition*, American School Publishing Corporation, New York, 1942. p.248-253

Essex, Don L., "What's What in Schoolhouse Building Design," *School Executive*, 66: 59-61 (December 1946).

Evans, Hubert M., "Science Laboratory Workshop For a Small School," *School Executive*, 65: 52-54 (July 1946).

Fallon, P. T., and Willard Allphin, "Model Classroom, One Year Later," *School Executive*, 66: 33-35 (January 1947).

Gilchrest, Robert L., and Norman Woelful, "Equipment Supplies, and Material for the Secondary School," *School Executive*, 63: 40-42 (July 1944).

Graham, C. C., "Some Science Material and Teaching Aids for Secondary Science," *Educational Administration and Supervision*, 27: 420-426 (September 1941).

Gray, Dorothy and Alice Miel, "A Laboratory for the Social Studies," *School Executive*, 66: 44-45 (July 1946).

Greene, C. W., "Master Lists and Storage of Equipment Used in High School Courses," *American School Board Journal*, 112: 51-53, January; 35-39 February, 33-36 April, 39-40 May, 113: 34-36 September, 47-48 November, 48-49 December, 1946.

Gunn, T. F., "Setup for Science," *Nation's Schools*, 26: 38-39. (July 1940).

Heard, Ida Mae, "Vitalizing Mathematics through Classroom Atmosphere," *Mathematics Teacher*, 35: 365-368 (December 1942).

Hingham Public Schools, *Analysis of Elementary School Program for the Replacement of the South Elementary School*, Hingham Public Schools, Hingham, Massachusetts, (Unpublished).

Holmes, Warren, "Biology Rooms at Lansing," *Nation's Schools*, 26: 42-43 (July 1940)

Johnson, W. H., "High School English Laboratory," *American School Board Journal*, 106: 31-33 (January 1943).

Joint Commission of Mathematical Association of America, Inc. and National Council of Teachers of Mathematics, *The Place of Mathematics in Secondary Education*, *Fifteenth Yearbook*, National Council of Teachers of Mathematics, Teachers College, Columbia, New York, 1940. 253 p.

Kee, Olive A., "A Mathematical Atmosphere," *National Council of Teachers of Mathematics*, *Third Yearbook*, Bureau of Publications, Teachers College, Columbia, New York, 1928, p. 268-276.

Kersey, Vierling, "Needed Flexibility," *Nation's Schools*, 26: 36-37 (July 1940).

Leib, F. I., "Designed for the Small School," *Nation's Schools*, 26: 44 (July 1940).

Martin, N. F., "Equipping a High School Geography Room," *American School Board Journal*, 98: 41-42 (June 1939).

Mossman, Edith L., "A Mathematics Classroom That Speaks for Itself," *School Science and Mathematics*, 33: 423-430 (April 1933).

National Council of Teachers of Mathematics, *Multisensory Aids in the Teaching of Mathematics, Eighteenth Yearbook*, Bureau of Publications, Teachers College, Columbia, New York, 1943, 455 p.

National Council on Schoolhouse Construction, Part I Proceedings of the Twenty-third Annual Meeting, 1946, 143 p.

National Society for the Study of Education, Committee on the Teaching of Science, *A Program for Teaching Science, Thirty-first Yearbook, Part I*, Public School Publishing Company, Bloomington, Illinois, 1932, 370 p.

National Society for the Study of Education, *Science Education in American Schools, Forty-sixth Yearbook, Part I*, National Society for the Study of Education, Chicago, Illinois, 1947, 306 p.

Orth, Albert A., "Planning the Social Studies Classroom," *American School Board Journal*, 92: 30-32 (January 1936).

Potter, Mary A., "Mathematics Laboratory," *School Science and Mathematics*, 44: 367-373 (April 1944).

Ramseyer, John A., "The Mathematics Laboratory -- A Device for Vitalizing Mathematics," *Mathematics Teacher*, 28: 228-233 (April 1933).

Rolfe, Stanley H., "Science in a Senior High," *Nation's Schools*, 26: 45-46 (July 1940).

Schorling, Raleigh, *The Teaching of Mathematics*, The Ann Arbor Press, Ann Arbor, Michigan, 1936, 247 p.

Smith, Dora V., "Evaluating Instruction in Secondary School English," *English Monograph*, No. 11, National Council of Teachers of English, Chicago, Illinois, 1941, 273 p.

Smith, Victor C., "Functional Science Classroom," *American School Board Journal*, 111: 46-48 (November 1945).

Stegmeir, Clarence C., "Pictures Teach History," *Social Studies*, 31: 298-300 (November 1940).

Syer, Henry W., "The Effect of Military Training Upon General Education," *Mathematics Teacher*, 39: 3-16 (January 1946).

Wiechman, J. B., *A Survey of Equipment and Material Used in the Social Studies Department of the Los Angeles Junior High School*, University of Southern California, 1930 unpublished Master's Thesis, abstract in *Historical Outlook*, 22: 174 (April 1931).

Wittkop, N. L., "Specialized Geography Room," *Clearing House*, 18: 85 (October 1943).

Wooden, H. E., A. B. Wrigley, and W. L. Lowe, "A Plan for a Social Studies Suite," *School Executive*, 54: 262-264 (May 1948).

Zaph, Rosalind M., "Classrooms as a Means of Stimulating Interest in Science," *Science Education*, 23: 206-209 (April 1939).

Date Due

JUL 5 1962
OCT 20 1962
APR 13 '64
R. J.
AUG 2 1965

Demco 293-5

BOSTON UNIVERSITY
1 1719 02561 4399

EDI COVER
NF 58138
roduct of W Co

Service Paper
Brackley, R.A.
1949
Brackley, Rufus A.
A survey of recent literature to
determine...

DATE	ISSUED TO
	~~208 784 STD~~
~~R.O.~~	~~Stanley Stoneius~~
AUG 2 1965	921 356 EXP 8 31 65
	J. A. Coran

DEMCO-209

Ed.
Service Paper
Brackley, R.A.
1949
Stored